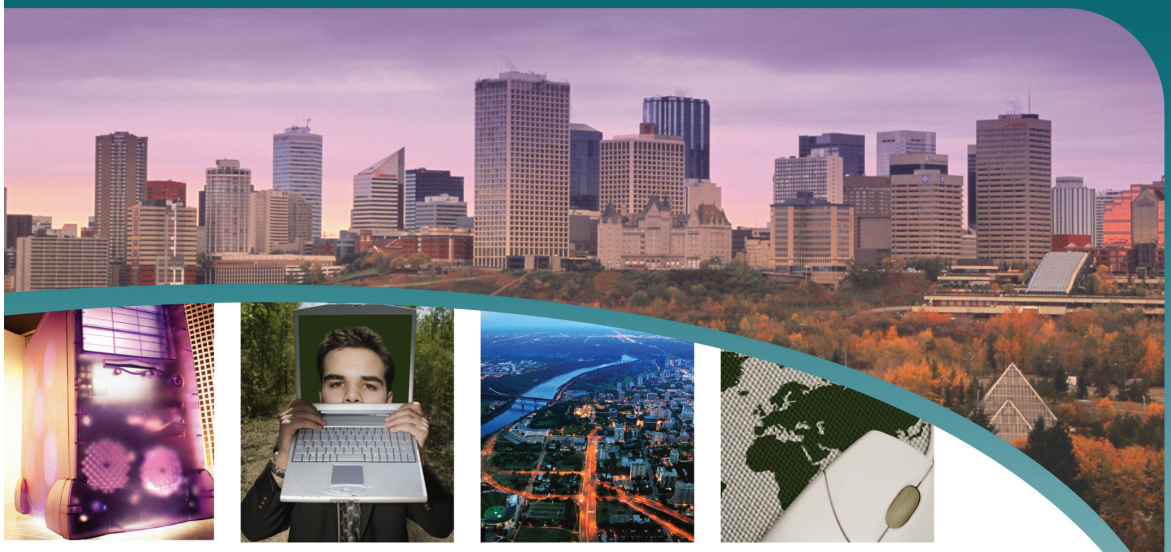

City-Wide Public Wi-Fi Service
Business Case on Model Options

April 2007

THE CITY OF Edmonton CORPORATE SERVICES

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Executive Summary

This report addresses the Executive Committee's request to research publicly-accessible municipal wireless networks and explore the feasibility and potential benefits of such an initiative for the City of Edmonton. This business case lays out options for a city-wide network, including potential business models, financials, risks, benefits and impacts.

A sustainable business case could not be determined for the City to implement a city-wide wireless broadband network to provide public Wi-Fi access. This conclusion is based on the following rationale:

Availability:

- Edmonton is well-served by existing private sector wireless and wired Internet access services and providers. More than 100 publicly-accessible hotspots and thousands of private consumer and business Wi-Fi networks exist within Edmonton. The market is highly competitive, with continuously evolving technologies and changing consumer needs that the private sector is best positioned to address. There is no significant gap in services or unfilled customer demand that would require municipal intervention. Offering city-wide Wi-Fi service would put the City in direct competition with private sector networks.

Financials:

- Creation and maintenance of a new, competing wireless network would not be economically viable. The costs to design, build, operate and manage a reliable and scalable wireless network with current Wi-Fi technologies are significant. Benefits are hard to quantify and the revenue model is unreliable and insufficient to cover costs. To date, large-scale city-wide deployments have not been able to demonstrate a sustainable financial model.

Risks and Implications:

- Protocols and standards, technologies, end-user devices and other elements that impact the economic viability of a wireless solution are changing at a rapid pace. Wireless services without an attractive price/performance point quickly become irrelevant. Additionally, none of the respondents to the City of Edmonton's Request for Information (RFI) indicated a willingness to assume network ownership risk on behalf of the City.

Five potential deployment scenarios and three business models were considered. None of the business models were deemed viable for the City of Edmonton.

Recommendations:

Recommendations based on the analysis are:

1. that the City of Edmonton not implement a city-wide Wi-Fi network to enable public Wi-Fi access.
2. that the City pilot a limited number of free hotspots in high traffic civic spaces. These would be in accordance with the seasonal needs of citizens and visitors, and would complement coverage already available at commercial sites.
3. that the City of Edmonton assume a role as facilitator in supporting initiatives as they emerge from community groups. On-going monitoring of developments in the area of municipal Wi-Fi should continue in support of this work.

2

Introduction

2.1 Information Request

"Publicly-accessible, low-cost wireless internet access is viewed as an enabler in improving the City's quality of life, image and attractiveness". These views were expressed in 2005 by members of the Next Gen taskforce, formed to create recommendations to attract and retain the "next generation".

In September 2006, the Next Gen taskforce presented a number of recommendations to the Executive Committee, including some specific to the City of Edmonton playing a role in expanding publicly-accessible, low-cost Wi-Fi services. The Executive Committee subsequently requested that the City's Corporate Services Department research publicly-accessible municipal wireless networks and explore the feasibility and potential benefits of such an initiative for the City of Edmonton. The Executive Committee recommended a business case be prepared and presented back on the various potential city-wide Wi-Fi business models. This business case lays out those options, including potential business models, financials, risks, benefits and impacts.

The objectives of this initiative are to:

- research the wireless technologies currently being used for municipal wireless broadband initiatives and existing wireless broadband services and coverage in the City of Edmonton;
- analyze current municipal Wi-Fi initiatives (including key drivers, business models, lessons learned and best practices) and potential business models and cost implications for the City in delivering wireless broadband service;
- present the results of the analysis and provide a recommended course of action.

The research methodology was based on Internet searches, telephone interviews, meetings and discussions with select ISPs (TELUS, Bell, Rogers) and with municipal and industry experts. A Request for Information (RFI) process was undertaken to solicit input from interested ISPs and technology vendors.

2.2 The Vision

People are increasingly mobile and want to stay connected by accessing information wirelessly. New wireless technologies have brought the vision of *"anytime, anywhere access to information"* much closer to reality. Wireless technologies are being deployed in homes and businesses to create low-cost, high speed wireless local area networks. Commercial wireless hotspots in airports and other high-traffic locations (e.g. retail/hospitality industry) are expanding. New wireless technology advances are being used to provide blanket coverage over cities.

Technologies providing city-wide wireless, publicly-accessible Internet access have been under development for a number of years. Municipalities are increasingly aware of the trends and opportunities afforded by wireless technologies. As these technologies continue to evolve, businesses and governments are starting to explore how cost-effective wireless broadband networks can be deployed and integrated into existing networks. Some municipalities, including the City of Edmonton, have deployed infrastructure and developed applications specifically designed to support their mobile workforce by extending the enterprise to the field.

Recent advances in wireless technologies have caused some citizens to advocate that municipalities have a role to play in providing publicly-accessible, low or no-cost broadband wireless Internet access. This is partly driven by the view that incumbent service providers' prices are high, that they provide limited coverage or that they only serve market segments that meet bottom-line business objectives.

3

Environmental Scan — Technologies and Architectures

3.1 Wireless Broadband Technologies

Broadband services are generally defined as data services that are fast, always available and capable of supporting advanced applications. The general standard used to distinguish broadband is data transmission speeds of 200 kilobits per second (200Kbps) or more. At this speed, for example, Web pages can be flipped as quickly as pages of a book and full-motion video is available.

There are a number of wired and wireless options currently available for delivering broadband services. Each has its advantages and disadvantages in certain applications designed to meet particular needs.

The primary technologies relevant for municipal wireless are ***Cellular Digital, Wi-Fi*** and ***WiMAX***.

3.1.1 Cellular Digital

Cellular Digital is the generic term for the wireless data service offerings from cellular mobile telephone providers such as TELUS, Bell and Rogers. Cellular networks provide ubiquitous coverage and have an extremely high adoption rate. Wireless carriers now offer coverage to more than 98 per cent of Canadians, and more than two-thirds of Canadians have access to wireless phones. *(Canadian Wireless Telecommunications Association — CWTA).*

Mobile phone technology has gone through many versions or generations. The latest mobile wireless broadband services provide speeds in major metropolitan areas ranging from 220 – 700Kbps. This enables cell phones to become "smart phones" which, in addition to the standard voice function, can support many additional services. Younger generations are the largest users of these services which include: text messaging, email, Internet browsing, access to corporate networks, music (MP3) playback, built-in cameras, games, radio, ability to watch streaming video and serving as a wireless modem for a PC.

Cellular networks use the licensed portion of the radio frequency spectrum. The costs associated with the licenses are high and ultimately passed on to the consumer. A device capable of fully utilizing these services costs $300 or more and service plans are based on megabytes used. The cellular marketplace is fiercely competitive. The next evolution (4G) offerings, which will be available within the next few years, promise significantly higher speeds and are expected to integrate aspects of Wi-Fi and WiMAX technologies.

3.1.2 Wi-Fi Technology

"Wi-Fi" is a brand name describing the set of product specifications **(802.11x)** used for wireless local area networks (WLANS). It was initially developed as an in-building LAN network for mobile computing devices and as a convenient and cost-effective alternative to cabling. **Wi-Fi operates at unlicensed radio frequencies** and has gained acceptance in the marketplace as an inexpensive in-building and outdoor option for providing wireless Internet access.

Users require Wi-Fi enabled devices to connect through Wi-Fi to the Internet. Most new mobile devices offer Wi-Fi radios as part of their standard equipment.

Wi-Fi is a point-to-multipoint technology which allows several clients to connect simultaneously. As more clients connect, the performance degrades.

Current municipal wireless implementations typically offer speeds of 500Kbps to 1Mbps. Current standards provide an indoor range of about 50 metres and an outdoor range of about 100 metres. Consumer grade Wi-Fi network cards have become commoditized and are priced under $100, while commercial grades, with greater security and user management features, are in excess of $2,000.

"Hotspot" is the term used to describe the area covered by one or several Access Points (APs). Hotspots are now widely available at high-traffic, public locations such as airports, hotels, convention centres, retail outlets and coffee shops. Large scale Wi-Fi networks covering a number of city blocks, a community or even city-wide are also being deployed, but since APs have limited range, large deployments require configuring many APs to overlap each other to form a continuous **"mesh"** network of wireless signals, similar to cellular technology.

3.1.3 WiMAX Technology

WiMAX is a longer-range technology, based on the **802.16** family of specifications, that also uses a point-to-multipoint architecture. As a **licensed frequency** band, it is more expensive to deploy than Wi-Fi. WiMAX can extend local Wi-Fi or cellular networks across greater distances or provide 'last mile' connectivity to a service provider or other carrier many miles away. WiMAX standards are still being developed and the technology is only starting to be incorporated in consumer mobile devices. As network convergence in mobility accelerates, the complexities of Wi-Fi mesh configurations will become more pronounced and the WiMAX access solution becomes more attractive. In the future, wireless providers will likely pursue WiMAX as a key component in their wireless networks.

3.2 Wireless Technology: Key Observations

Wireless technologies are in a state of rapid change:

- Data transmission speeds are roughly doubling each year;
- New protocols and standards are being developed;
- Older protocols are being enhanced through new standards that increase speed, range, security and mobility features; this is enabled through equipment upgrades;
- Wireless systems of the future will evolve to a single infrastructure that supports different wireless access technologies (Wi-Fi, WiMAX, Cellular and the 4.9GHz public safety band). These technologies are evolving independently at different rates, but moving towards convergence;
- Convergence on the consumer side is already evident and will increase. Dual mode Wi-Fi cellular handsets are coming to market now, and when mobile WiMAX arrives, it will commonly be combined with a Wi-Fi client.

In the long-term, this evolution will be positive for the consumer. Short-term, there is risk in investing in large wireless deployments based on Wi-Fi technology. Particular concerns include:

- Continuous availability cannot be guaranteed. Wi-Fi operates in unlicensed radio bands, so there are no controls on who or what can share the limited number of bands. As usage grows,

so does the potential for interference issues and faltering connections;

- Consistent service levels will be difficult to maintain. Wi-Fi bandwidth is shared, and performance degrades with multiple simultaneous users. When performance is degraded, high performance applications such as streaming video and audio can be an unsatisfying experience, making alternate broadband technologies more attractive;
- Additional equipment (CPE) would likely be required to facilitate in-building Internet access to outside access points. Coverage may require numerous antennas to increase coverage or boost signal strength, because of Wi-Fi's, short-range and, limited ability to penetrate building walls or reach above the second floor.
- Interoperability challenges with other technologies. WiMAX is an emerging technology viewed as a complementary technology to Wi-Fi. As a licensed frequency band, it is more expensive to deploy than Wi-Fi, and current implementations include proprietary technology.

Of the three technologies, Wi-Fi has emerged as the forerunner for municipal wireless deployments. It is a good, low-cost solution, and is easy to deploy in smaller public places (e.g. coffee shops, hotels, shopping malls).

3.3 Edmonton: Local Market Wireless Coverage

Statistics indicate local telephony and Internet usage is strong and the market is well served. *Alberta Finance Statistics 2003* reports 58% of the population used the Internet at home, 42% at work and 40% at a school/library/other, for a total usage rate of 69% at any location. City of Edmonton statistics *(www.edmonton.ca/City/Gov/Comm Services)* indicate Internet access from the household has increased rapidly, from 34% in 1999 to approximately 60% in 2003. This growth rate is continuing, as supported by the **2005 Canadian Internet Use Survey** which indicates that 69% of Edmontonians aged 18 and over use the Internet.

3.3.1 City of Edmonton — Broadband Coverage

More than 50 Internet Service Providers (ISPs), including telecommunication and cable companies, offer Edmonton and area a variety of Internet services for both residential and business customers. In addition to cellular networks, Edmontonians have a variety of broadband technology choices. Almost every business and residence has a choice of cable or DSL fixed wireline Internet access from several providers, priced from $30/month, These services provide speeds from 1Mbps — 8Mbps. Lower cost dial-up service (56Kbps) is also available. Several providers also offer to provide wireless access by mounting an antenna in private residences or business locations.

Edmonton is well served with wireless Internet access, as evidenced by the following:

- **Cellular Coverage:** Edmonton is covered by cellular data services wide-area networking technologies that provide comprehensive, ubiquitous, reliable and seamless coverage at speeds from 400 – 800Kbps.
- **Wi-Fi / Commercial Hotspots:** There are more than 100 publicly accessible hotspots in strategic, high-traffic locations throughout Edmonton, such as hotels, restaurants, retail outlets, golf courses and coffee shops (see www.jiwire.com for a partial list of locations). These hotspots are a mixture of free and fee-based wireless Internet access points provided by commercial establishments as a customer service differentiator and/or revenue generator.
- **Educational Institutions:** Edmonton's post-secondary educational institutions, including the University of Alberta and NAIT, provide Wi-Fi access for their student population. Coverage often extends beyond their buildings to outside common areas throughout their campus sites.
- **City Libraries:** All Edmonton Public Libraries offer free Internet access, through approximately 350 computers. In 2007, indoor Wi-Fi access points are also being deployed throughout library buildings to allow the public to connect to the Internet using their own Wi-Fi enabled mobile devices.

Alberta's provincially-owned and funded SuperNet is a high-speed and high-capacity broadband backbone. It extends throughout Alberta and is utilized within Edmonton by schools, libraries and hospitals. The network provides direct access to public facilities and, more recently, through service providers to businesses and residences in Alberta communities. SuperNet uses an open access model which allows local service providers to buy bandwidth at reasonable, uniform rates across the province for resale to business and residential customers. Axia is the private company contracted by the Government of Alberta to manage commercial access to SuperNet.

3.4 Municipal Wireless

3.4.1 Background:

According to *InformationWeek (November 2006)*, more than 300 cities and counties in the US are either considering or deploying municipal Wi-Fi networks. This is triple the number reported in early 2005. While numerous small-scale successes exist, few large-scale municipal Wi-Fi initiatives have been implemented that could serve as a benchmark. Many of the planned large-scale initiatives have undergone changes in scope, timing, technology and funding models.

A number of prominent municipal wireless initiatives recently completed or currently underway were researched in order to understand the context, drivers, business models, issues and key lessons (see Appendix A).

3.4.2 Drivers & Business Case

There are three common drivers behind municipal wireless initiatives:

1. Enhancing the delivery of government services;
2. Strengthening economic development;
3. Improving the quality of life for citizens through increased access to information.

Typically, all three are evident, but the emphasis differs depending on a particular city's context.

The business case for enhancing the delivery of government services is usually clear and compelling. Many municipalities have deployed infrastructure and applications specifically designed to support their mobile workforce, track assets, monitor remotely, provide surveillance, etc. The benefits in enhancing service delivery and cost savings compared to commercial network providers' rates tend to be easily demonstrable and provide a quick payback. Many cities, including the **City of Edmonton** have considered this route.

A variation of this occurs when a community is seriously underserved by the incumbent providers, or broadband services are deficient or too expensive. In these cases, city officials may partner with businesses and leverage their combined resources to provide improved services. The business community helps pay for the infrastructure. **The City of Fredericton**, where excess capacity is offered to support publicly accessible Wi-Fi services, is an example.

The business cases for the other two drivers are more difficult to measure and often lack strong tangible benefits. In some municipalities where these are the drivers – such as Philadelphia and San Francisco – commercial providers, citizens and taxpayer associations have expressed concerns with the notion of cities creating government-owned and funded wireless networks to compete with private sector networks. This has prompted debate about the issues surrounding municipal wireless, and recent legislation in the US has curtailed these types of ventures.

While the above examples are more common, research also uncovered an example of a more business-focused implementation, **Toronto Hydro Telecom (THT)**. Initially THT's initiative focused on providing the public with wireless service which was a result of the the planned expansion of its infrastructure to implement automatic meter reading. As the utility analyzed the business opportunities in wireless, it entered into this line-of-business on a commercial basis, positioning itself as an alternate ISP whose pilot is focused on a select area of the downtown core. This decision places THT in competition with the incumbents and multiple other ISPs.

3.4.3 Business / Funding Models

A number of municipalities have tried to leverage their own internal broadband networks to provide publicly-accessible wireless Internet access service. Where legal and regulatory hurdles have prevented municipalities from getting into this line of business, some have set up separate entities and/or sought business partners to complete their projects.

Early attempts to expand or create new networks have shown that deploying, managing and maintaining a network of acceptable quality is a major, costly and risky undertaking beyond the scope of most municipalities' competencies. The risks can be considerable and need to be mitigated. A key challenge for wireless initiatives is funding.

Two factors need to be considered:

- Who will pay the cost of constructing the network?
- How will the costs of operations and continuing equipment upgrades be covered?

Decisions regarding these funding factors are largely driven by decisions surrounding the degree of ownership and control a city wants over the network and the purpose of the network.

Clear and concise answers to questions including: "What needs are we trying to satisfy?", "Who are the users?", "What are the requirements?", "What benefits are we striving to achieve?" and "What amount of risk is the city willing to assume?" must first be determined. These answers would help identify the technology and operating model required to meet the customer care, service development, network operations and management requirements.

Model choices cover the spectrum from independent not-for-profit community grassroots initiatives to fully city-owned and funded (see Appendix B for descriptions).

Case studies and industry research indicate **large-scale municipal wireless deployments tend to favour a managed-service or public/private**

partnership model. Agreements tend to share the following characteristics:

- A city enters into a partnership agreement with a major ISP which agrees to design, build and run the network for the city;
- Funding is provided by the ISP, with revenue streams expected from retail and wholesale subscription fees, as well as advertisements;
- Service plans are tiered and priced accordingly, often including a free component based on slower access rates. Most municipal plans have provisions for higher speed tiers at varying price points;
- The city directs some of its municipal applications to the network and acts as an anchor tenant to ensure the network's financial viability;
- The city is expected to support the initiative by making its assets (e.g. lamp posts, municipal buildings) available to the service provider to locate the infrastructure;
- The city negotiates some ad-generated revenue sharing, or receives discounted service rates for specific customer groups or geographic areas to address the "digital divide".

Examples of this type of agreement are:

Municipality	Partner Company(s)
Philadelphia and **San Francisco**	**EarthLink** and **Google**
Portland, Oregon	**Microsoft** and **MetroFi**
Riverside, California	**AT&T**
Silicon Valley, California	**"Metro Connect" (Cisco Systems & IBM)** and **Aluzar**

Note: the favourable terms offered by the ISP and major equipment provider on the early contracts with the cities of Philadelphia and San Francisco were offered in part to establish "test beds" in the marketplace for their technical solutions. Subsequent contracts with other cities tended to have fewer concessions.

3.4.4 Lessons Learned — Key Observations

The following are key observations resulting from a review of municipal wireless broadband initiatives' case studies and technical research. They represent risk elements that need to be factored into decisions about the potential role of municipalities in wireless broadband initiatives:

Cost Risks:

- Maintenance and replacement costs
  - upfront costs tend to be deceptively low and escalate rapidly when factoring in yearly maintenance and equipment replacements costs (approximately 50 per cent replacement/upgrade every three to five years);
- Costs of large-scale offerings
  - significantly higher expenditures are incurred when deploying the carrier-grade networks required for pay-for-use or subscription services. Costs can quickly skyrocket due to network redundancy, provision of power, customer service, anti-hacking security measures, billing and other management and administrative cost requirements. For example, Philadelphia's costs doubled from the original estimates;
- Cost of additional equipment for in-building access
  - Internet access within buildings poses a challenge and would likely require subscribers to purchase additional equipment. This lessens the attractiveness of the service offering.

Revenue Risks:

- Many large-scale or city-wide deployments have not been able to cover their costs without being subsidized by taxpayers or rate hikes. A wireless network for which nobody pays isn't viable. If the government pays, it is usually inappropriate and, if ads pay, it is usually unreliable. Large municipal networks are increasingly seeking subscription-based and pay-for-usage revenue streams to be viable;
- Subscriber willingness to pay is proving to be below expectations:
  - Users are more inclined to experiment with free access service. This is causing lower than anticipated take rates when switching from free access to pay-for-use.

    Preliminary information from Taipei, Taiwan suggests a very low subscription rate. With a population of 2.6 million people, only 60,000 users registered for the free trial period. Of those users, only 10 per cent (6,000) continued to use the service when required to pay for it.
  - Commercial Hotspots are not generating sufficient revenues, causing establishments to increasingly view them as a value-added service rather than a revenue generator.
  - Health concerns, security of data and information privacy concerns may adversely affect subscriber take rates.

Technology Risks:

- Few large-scale Wi-Fi municipal deployments have been implemented that can be used as a technology benchmark. Most have been small-scale;
  - uncertainty still remains over whether large-scale networks will be able to overcome their technical challenges. Wi-Fi was originally designed for use in small areas or zones.
  - Wi-Fi is not a technology designed for large full-coverage municipal developments.
- Wireless technology is rapidly evolving and there is a risk that current Wi-Fi deployments could be leap-frogged by newer versions of cellular and, eventually, WiMAX.
  - both technologies promise speed and coverage advantages. Current Wi-Fi deployments may rapidly become outdated;
- There is no common standard for Wi-Fi meshing, and thus no compatibility between the five leading vendors' equipment;
- Technical problems can persist long after deployment, regardless of scale or resources (Taipei, Taiwan).

Health Concerns:

The potential detrimental health effects of human exposure to Radio Frequency (RF) are starting to get more attention, and the debate impacts wireless broadband initiatives because Wi-Fi services are based on RF. While many studies have suggested these concerns are unfounded, organizations such as the Lakehead University in Thunder Bay, Ontario have banned further Wi-Fi deployment until further studies either refute or support the health concerns. While there is value in wireless connectivity in situations where people are not working from fixed locations, such as airport lounges, the benefits are more tenuous in locations where fixed-line Internet access is readily available.

Wi-Fi network equipment must comply, at a minimum, with Industry Canada's federal standards that address exposure to electromagnetic radiation. While a Wi-Fi deployment would not contribute significantly to the overall level of signals that make up the radio environment, it is impossible to prove there is no risk. Cities should expect public concern about city-wide wireless deployment in which access points are clearly visible on city streets.

Security and Privacy

Internet-based crime is increasing. Reports of financial scams and the distribution of pornography on the network frequently make headlines, and it is challenging to track down the perpetrators. Law enforcement agencies are concerned that unrestricted wireless access would offer criminals an alternative where tracking would be even harder. These risks cannot be completely mitigated, but the visibility of a city-owned network would require the municipality to employ user registration and authentication. This would increase the cost of the network and could conflict with public views of privacy and unimpeded access. Similar concerns are expressed with ad-based and location-based content revenue. Many users view content filters, ad-based and location-based content applications as an infringement, and may avoid wireless deployments on those terms. Citizens' resistance to the deal San Francisco negotiated with EarthLink and Google is a case in point.

Regulatory Issues:

Canadian municipalities considering city-wide wireless deployments must investigate potential regulatory issues. Wi-Fi is telecommunications, and large-scale Wi-Fi initiatives may have to comply with Industry Canada requirements and/or provisions of the *Telecommunications Act*, administered by the CRTC.

These key observations corroborate the issues and concerns with large-scale municipal Wi-Fi initiatives.

In summary, large-scale wireless broadband networks remain experimental enough to warrant caution.

4

Financial Implications — Wireless Networks

4.1 Cost Implications

Designing, engineering and costing a wireless broadband deployment involves design decisions about many variables, including coverage, density, topology, existing spectrum and type of service. These decisions affect both equipment and technology choices. Cost data for deploying municipal Wi-Fi implementations is not readily available. While high-level figures have been quoted, cities and ISPs do not volunteer confidential cost data and revenue forecast details. High-level cost information quoted in media stories often reflect pricing scenarios and assumptions which are more positional statements than contract pricing.

An often-utilized cost figure for municipal wireless networks is provided by Jupiter Research *(Wi-Fi Planet News, July 6 2005)*. Based on surveys and conversations with vendors and 83 cities that have deployed or are in the process of deploying some form of a wireless network, Jupiter Research concluded that "the average cost of building and maintaining a municipal wireless network is **$150,000 USD per square mile over 5 years**", approximately $70,000 CAD per square kilometre. Local sources suggest this cost figure is too low and would likely be significantly higher. The report goes on to say that "about half of the initiatives today to create city or county-backed wireless networks will not break even, even if they charge end users as much as $25 (US) per month in subscription fees".

Installing a single access point in a controlled indoor environment is a fairly simple undertaking. An outdoor installation raises many more challenges because of environmental factors, mounting locations, heating/sheltering needs, power source and backhaul requirements. Implementing and managing a city-wide wireless broadband network providing both indoor and outdoor connectivity is a complex undertaking with many unknowns that need to be surveyed, engineered and constantly monitored.

There are significant costs to establishing and maintaining ongoing operational management processes for a large-scale, multi-service, pay-for-use network implementation. The magnitude of each identified activity or business process is a function of the geographic area to be covered, the number of users and service levels being planned. Each has associated capitals expenditures and operational costs which must be factored into the business case.

4.1.1 High-Level Cost Calculations

Ball-park costs for a number of scenarios are outlined in the table below. In the absence of specific requirements, the cost estimates provided for the purpose of this analysis are high-level and based on a large number of assumptions.

Cost	Coverage Area	Assumptions	Rationale
In excess of $50 Million	City-Wide Mesh deployment	Carrier grade with all supporting business processes, billing, customer care, security, content filtering, etc.	Industry standard of $70,000 CAD/sq km. Edmonton contains 684 sq km.
$70,000 /sq km Minimum plus ongoing operational expenses	Hot Zone (multiple Access Points) Mesh deployment	Costs can vary greatly according to the terrain, the type of coverage, the service grade designed for and the technology set deployed. This figure is on the low side, with limited coverage.	As above, costs will likely be significantly higher because of lower economies-of-scale and urban vs. rural coverage challenges.
$9,000 each	Single Access Point Outdoor	City install in/on a City-owned facility using the facility's connection to the City network to provide public access to the Internet; no on-call support.	An example would be Wi-Fi service in Churchill Square. It would likely require 4 APs, for a total of approximately $27,000.
$6,000 each	Single Access Point Indoor	City indoor install — same as above	An example would be an AP at City Hall.
$6,000 plus $7,200 yearly	Single Access Point — Indoor	Commercial ISP installs Indoor	AP = approx $6,000 plus monthly backhaul charge of $600. Equals $13,000 in year 1 and $7,200 annually afterwards; plus customer pays usage charges.

Note: Wi-Fi is a shared network, and performance degradation is experienced with additional users and applications being run. This requires constant usage monitoring to determine if additional APs (cells) are required to handle the volume.

4.2 Revenue & Demand Forecasts

While high-level costs can be estimated based on a large number of assumptions and constraints, user demand and revenue forecasting is much less accurate and thus riskier in the absence of an in-depth market analysis and a stakeholder engagement process. There are a number of key observations from the research that indicate large-scale municipal Wi-Fi initiatives can be a financially high-risk undertaking.

Municipal networks must often seek subscription-based and pay-for-usage revenue streams, in addition to other more creative funding, in order to be viable. This requires a carrier-grade network offering competitive services and a value proposition better than existing networks in order to gain market share. Given that the Edmonton market is well served and the user communities currently have multiple service options, the need to capture a significant user base in the face of a competitive marketplace is a high risk.

A blanket Wi-Fi deployment in Edmonton would probably require in excess of $50 million dollars. There has to be a sustainable financial model to support this level of capital investment and the post-implementation operating costs. Current municipal models rely on a combination of user subscriptions, ad-generated revenue and fixed revenue streams from the municipality as an anchor tenant. To date, there is little evidence that these models have been successfully established.

The following points illustrate the revenue risks:

- **Willingness to Pay:** While the number of hotspots is growing, the willingness to pay is not keeping pace. Jupiter Research (November 2003) indicated that while 70% of online consumers were aware of public hotspots, only 6% have used the service in a public place, and only 1% have paid to use it in a public place;
- **Competition:** Government-sponsored broadband will have to compete with incumbents, such as telecommunication companies, cable companies and other ISPs who already have a substantial head start. To retain market share they may employ powerful marketing tools and introduce or expand loyalty programs, service bundling, etc.;
- **Limited Market:** Existing Wi-Fi vendors have already explored all the commercially viable, strategic locations and high-use target markets. A municipal initiative may not attract enough users to make the business viable;
- **Marketing Focus:** In the face of dynamic competition and swift technology change, the network owners must adopt professional private-business management and marketing practices and processes in order to ensure a positive customer experience and a compelling value proposition;
- **Continuous Innovation:** The market requires continuous innovation — improving the price point and service offerings to ensure the value proposition remains compelling and customer churn (whether due to Price, Selection, Service, or Innovation) is managed;
- **Churn:** Using the highly competitive cellular industry as an example, customer churn rates are significant and can range between 25% – 35% of the base yearly. ISP churn rates average 4% to 8% per month (48% – 96% per year). *(Network World 11/12/01)*. An article in **C/Net News.com (Jan 02. 2002)** suggests that "Internet Service Providers are suffering from monthly subscription cancellation rates that are five times greater than those of telecommunications services such as cellular phones, pager and long distance carriers". This is potentially a huge threat to the forecast revenue streams, and represents a financial risk to the network;

- **Price/Performance:** Market share can only be achieved if the price/performance combination is viewed by the consumer as being superior to what the competition offers. If the technology and performance level is the same – a big assumption for a new entrant – then the only lever a municipal initiative has is to lower the price point to buy market share.
- **Capital Requirement:** The incumbent telecommunication and cable companies have depth of capital and are in a better position to build and update their networks.

In summary, the barriers to entry are much more formidable against entrenched competition than most municipalities realize. The Edmonton broadband Internet access market is well-served by incumbents. The market is fiercely competitive and there would be an aggressive response from incumbents.

5

Deployment Options / Impact Assessments

5.1 Options

Cities have a number of options for deploying publicly-accessible Wi-Fi Internet access. The following covers the spectrum of most likely options:

1. Do Nothing — Rely on the Private Sector
2. Selective City-owned Wi-Fi Locations (Hot zones)
3. Corporate Wholesale
4. Public Utility
5. Public-Private Partnership (P3)

Each option is described along with an assessment of the financials, risk profile, benefits and impacts.

Do Nothing — Rely on the Private Sector:
Even if the City chooses this option, the "wireless city vision" will likely be realized eventually through the private sector.

This would not preclude the City from any involvement in public access wireless deployments as it could assume a role as facilitator in supporting grass roots initiatives as they emerge from community groups.

The impact to the City of this option is minimal: no costs to the City, no associated risks and no incremental benefits to those already delivered by private industry. In the case of small grassroots initiatives, the benefits from a City perspective are limited, as they would only accrue to a small group.

Costs	Risks	Benefits	Ownership / Control	Comments
Nil	Nil	N/A	Nil	Private Sector driven with separate "grassroots or local business association initiatives. There are no incremental benefits unless the City supports the initiatives.

In anticipation of requests for access to City assets, it is recommended the City review its policies and applicable regulations regarding the use of City assets, such as lamp posts and other vertical infrastructure.

Selective City-owned Wi-Fi Locations (Hot zones)

The market for hot spots is well-served by more than 100 commercial sites (e.g. in hotels, high-traffic mall, coffee shops) provided by the private sector. They have established service primarily in areas and venues that meet revenue objectives or are financially supported by the hosting business. Wi-Fi connectivity in other areas of the city would be established as a public service to augment what the private sector has provided on a pay-for-use basis with no expectation of cost recovery or profitability. Service levels would be "best effort" with no on-call or after hours support. These zones would not be seen as competing with the private sector, and citizens retain the option of using other existing wireless services while in these areas. Costs would be controlled by establishing these zones in areas where City-owned network facilities could be utilized. Examples of such locations include:

- City Hall;
- Churchill Square;
- Public Libraries;
- Recreational Facilities.

The impact to the City of this option is minimal. Costs are comparatively low and using Wi-Fi technology while connecting through the City's network to provide a minimally supported service minimizes the risks. The benefits are likewise deemed low. Low usage is anticipated with outdoor usage projected as seasonal. The City would have total ownership and control of the network. Establishing smaller pilot sites is recommended before undertaking any hot zones.

Costs	Risks	Benefits	Ownership / Control	Comments
Low	Low	Low	High	City-owned and controlled — positioned as a public service for convenience and to reinforce an image.

Corporate Wholesale

In this model, a city segregates municipal traffic on its wireless network so that excess capacity can be leased to wholesale providers (ISPs) who then offer service directly to the public. The ISPs operate and manage the public portion of the network, including marketing and billing, thereby minimizing the city's involvement, but similarly limiting the potential benefits because the private sector becomes an additional vendor in the value chain.

The City of Edmonton is considering deploying wireless broadband technologies to meet internal needs. The network is based on a different technology set and is not suitable for public Wi-Fi access. This network is essentially an extension of the City's corporate network with robust security mechanisms in place to ensure safe and secure transport of corporate data and voice communications.

If the City were to pursue this option, it would require a significant design change to the current network and add significant costs to create, manage and wholesale excess capacity at contracted service levels. The benefits are deemed low because capacity would only be available in those geographic areas where the City intends to have a network presence. The use of third party private-sector ISPs increases costs of delivery.

Costs	Risks	Benefits	Ownership /Control	Comments
Med	Med	Low	Med	Performance of the network is City controlled, however the user experience and price points (key churn factors) are a function of the ISPs.

Public Utility:

This model would require the City of Edmonton to create or use an existing municipally-owned utility to design, build and operate a wireless network. The City would compete in the marketplace as a public utility against the private sector, providing broadband services directly to business and residential customers. The City would own the network, and manage all the customer care, (e.g. support, subscriptions, SLA, billings, product management) maintenance and operations of the network, as it would for municipal water, gas or electricity.

Because the City would have total ownership and control of the network, this model provides the best opportunity to maximize the benefits to the citizens of Edmonton by leveraging off existing infrastructure and established business processes and systems. However, this model also provides the highest risk to taxpayers:

- The City would have to finance the total capital and operating costs of the network, the City would be directly competing with the private sector in an area where it has little expertise;
- The City — and ultimately taxpayers — would incur all the risks described in this report (i.e. cost, revenue, technology, performance, competition, and political);

Costs	Risks	Benefits	Ownership / Control	Comments
High	High	High	Total	While existing infrastructure, business processes and systems can be leveraged, the business environment is fiercely competitive, high risk, bottom-line oriented and quite different from a public utility environment. Taxpayers end up assuming all the risks.

Public-Private Partnership:

This is currently the most widely deployed model. In this model, the City would essentially offer a franchise to a third party ISP who, through a competitive bidding process and a legally-binding contract, would partner with the City. Together they would finance, design, build and run the network. The City would remain actively involved throughout the project's lifecycle; providing assets and sharing responsibilities and risks. The private sector would be responsible for the more commercial functions, such as project design, construction, financing and operations of the network.

As outlined in Appendix B, cities are typically responsible for offering tangibles. These could include permission to use the rights-of-way and city assets (i.e. vertical infrastructure for mounting equipment), and potentially guaranteeing a revenue stream by acting as an anchor tenant for some of its municipal applications. This allows the private sector partner to minimize their risks and costs.

This option could potentially offer a number of advantages to the City. The private partner would assume the majority of financial obligations and costs. Risks would be borne largely by the private partner. Benefits to Edmonton citizens and businesses, by virtue of increased competition, could include improved availability and reduced cost of services. It provides the City some influence in the deployment and operations of the network, and there is potential for the City to either receive some revenue or discounted service rates.

There are also some caveats with this business model, as evident in the cities of Philadelphia and San Francisco examples):

- Having set public expectations, the City would be quite dependant on the third party vendor to deliver. If the network were used for City applications, the City would be incurring risk to ensure the vendor delivers on commitments and the network stays current and provides the level of service required;
- The financial model has to be workable for the successful proponent; and
- The City must be able to commit a certain amount of business as anchor tenant of the network. In Edmonton's case, the preferred solution was to build its own, internally-focused network to run critical wireless applications. No opportunities have been identified to use a public network based on current Wi-Fi technology.

The impact assessment could be as follows:

Costs	Risks	Benefits	Ownership /Control	Comments
Med	Med	High	Low	The strengths of both sectors, public and private can be brought to bear IF there is a sufficient market and a strong business partner.

In order for this model to work, there must be a willing and credible business partner to contract with. One was not identified in the RFI process the City undertook in November 2006.

City's 2006 RFI Process:

To better understand the options and likely business and financial models, Corporate Services issued an RFI in November 2006, inviting interested parties to submit a response relating to the provisioning of publicly-accessible, low or no-cost, high speed Internet access service in the city of Edmonton. The intent of the RFI was to conduct a preliminary assessment of the alternative solutions that may be available to the City for partnering with the private sector to improve wireless service within the City. Specifically, the RFI requested interested suppliers to outline, in their proposal the relevant information required to provide a generic understanding of the proposed approach, technology, timeframe, high-level cost figures, revenue forecasts, ongoing management, proposed business model and critical success factors.

A mixture of Carriers, ISPs and technology firms responded to the City's RFI. No respondents provided cost information, revenue or demand forecasts. The Mobility Communications companies all advocated a cautionary approach, proposing to lever off the systems, processes and resources that already exist in their core cellular networks and hotspots, and augmenting this as required. All respondents struggled with identifying a business case that would be financially viable.

6 Conclusion

Identifying the most appropriate business model is a function of the business needs or opportunities being addressed. Specifically:

- What are the reasons for doing this?
- What needs or opportunities are we trying to satisfy?
- Who are the users?
- What are their requirements?
- What benefits are we striving to achieve?

The answers to these questions, and whether or not there is a business case for the City of Edmonton to undertake a city-wide or expanded deployment of wireless Internet access, can be determined by reviewing the three top priority drivers for municipal deployments:

- **Enhancing the Delivery of Government Services:** The City understands the benefits available from the application of wireless technologies. Wireless initiatives have been undertaken, and the City's IT Branch is currently piloting a wireless network infrastructure that is designed to cost-effectively support many of the City's internal mobility needs. This network is essentially an extension of the City's corporate network with mechanisms in place to ensure safe and highly secure transport of corporate data and voice communications. The City has chosen to develop its own, internally focused wireless network to meet the needs of the municipal workforce and business processes. This is due to security concerns, network management requirements, cost considerations and the growing demands of City internal users for time-critical systems throughput and responsiveness. The City is not considering a public network as an appropriate or cost-effective vehicle for meeting its needs.

- **Strengthening Economic Development:** Edmonton has a strong Information and Communications Technology (ICT) infrastructure, and its wired and wireless Internet access needs are adequately served. Publicly-accessible hotspots have been provided by more than 100 commercial establishments as a value-add for citizens, tourists and business travelers. Educational institutions and City Libraries provide wireless coverage. Research suggests that when a city has a strong ICT infrastructure and numerous wireless service providers, the benefits of an additional city-wide publicly-accessible wireless network to provide Internet access are tenuous. Unless a new network is designed to meet specific, well-articulated needs, and is supported by a strong business sponsor, there is no sustainable business case for the City to venture into this area. While the City may have a role in facilitating some initiatives, it is the Edmonton Economic Development Corporation (EEDC) and/or similar business groups and associations that should be the main drivers.

- **Improving the quality of life of citizens through increased access to information:** Implicit in this driver is the view that the market has failed to deliver affordable broadband solutions to the population. Review of the existing Edmonton market broadband coverage does not support this case. For the majority of citizens, Internet access via hotspots, in addition to the cellular network, is a convenience that contributes to increasing the quality of life for some citizens and may enhance the image of the City. The commercial value of these benefits is hard to measure. While the demand for an additional pay-for-use wireless network is hard to gauge, the use of wireless continues to increase among all

demographics. Building a wireless network that provides connectivity to citizens with Wi-Fi enabled devices will not solve the bigger problem for citizens caught on the wrong side of the digital divide.

Should the City provide free or low-cost additional coverage in select pubic places, it may be viewed as contributing to an improved quality of life for some citizens and an enhanced City image. Running a number of pilot projects would confirm demand and potential benefits.

To summarize, a sustainable business case could not be determined for the City of Edmonton to enter the marketplace and develop a Wi-Fi technologies-based wireless broadband network to provide public city-wide access. This conclusion is based on the following rationale:

Availability:

- Edmonton is well-served by existing private sector wireless and wired Internet access services and providers. More than 100 publicly-accessible hotspots and thousands of private consumer and business Wi-Fi networks exist within Edmonton. The market is highly competitive, with continuously evolving technologies and changing consumer needs that the private sector is best positioned to address. There is no significant gap in services or unfilled customer demand that would require municipal intervention or entry into the marketplace. Offering city-wide Wi-Fi service would put the City in direct competition with private sector networks.

Financials:

- Creation and maintenance of a new competing wireless network would not be economically viable. The costs to design, build, operate and manage a reliable and scalable wireless network with current Wi-Fi technologies are significant. Benefits are hard to quantify and the revenue model is unreliable and insufficient to cover costs. To date, large-scale city-wide deployments have not been able to demonstrate a reliable financial model.

Risks and Implications:

- Protocols and standards, technologies, end-user devices and other elements that impact the economic viability of a wireless solution are changing at a rapid pace. Wireless services without an attractive price/performance point quickly become irrelevant. Additionally, none of the respondents to the City of Edmonton's Request for Information (RFI) indicated a willingness to assume a network ownership risk on behalf of the City.

7

Recommendations

In short, the recommendations are:

1. that the City of Edmonton not implement a city-wide Wi-Fi network to enable public Wi-Fi access.
2. that the City pilot a limited number of free hotspots in high traffic civic spaces. These would be in accordance with the seasonal needs of citizens and visitors, and would complement coverage already available at commercial sites.
3. that the City of Edmonton assume a role as facilitator in supporting initiatives as they emerge from community groups. On-going monitoring of developments in the area of municipal Wi-Fi should continue in support of this work.

A

Appendix A — Case Studies

The following contains details of various cities' major wireless broadband initiatives.

US & International Cities:

Austin, Texas:

Austin, Texas — population of 690,300; metropolitan area population of 1.4 million; encompasses city area 670 sq km, population density of 1,008/sq km.

Cisco Systems Inc. built a "*central Austin downtown wireless mesh*" as part of the World Congress on Information and Technology held in Austin in May 2006. The City decided to take the concept even further with larger hot zones offering free Internet access. The network uses the City's fibre optic network for backhaul. The City's strategy is to promote and foster different associations and co-operatives to provide expanded access. The City supports these initiatives by providing access to its facilities for wireless components mounting sites. To support economic development, Austin intends to use the network as a test lab for local companies to test new products.

Model: Non-Profit/Community:

A non-profit corporation, Austin Wireless City, was established to run and maintain this network. It will fund, market, manage, support and secure the expansion of free wireless Internet access. Domain experts and community leaders will assist efforts and help guide the vision. Austin Free-Net (AFN) has been established to provide technology planning, installation, training and support. The goal is to ensure that underserved communities can access and effectively use the Internet and computer technologies in public spaces throughout Greater Austin.

Madison, Wisconsin:

Madison, Wisconsin — population of 221,600 with more than 400,000 in the greater metropolitan area; city area is 136 sq km, population density of 1170/sq km.

The City wanted a seamless wireless network available to residents, businesses and travelers to the Madison area. The goal was to create a consistent wireless Internet experience throughout the city and minimize redundancy, expense and inconsistency of coverage.

Despite many local Internet service providers, the City believed there was a need to provide expanded coverage at a more affordable price. A Wi-Fi initiative, called "Mad City Broadband", was undertaken by the City. Cellnet was contracted to build and manage the Wi-Fi network. In addition to providing public access, the City intended to use the network for municipal applications such as meter reading, police communications and tracking City vehicles. The network is being deployed in phases, starting with a 10-mile radius from the city centre. By contracting with a third party, Madison avoided infringing on state legislation which prohibits municipalities from getting into telecommunications.

Model: Public-Private Partnership:

Cellnet was selected to build-out the network. It will offer wholesale access to ISPs and users on a fee-basis. In exchange for using the City's facilities to locate wireless equipment, certain designated areas, including economically disadvantaged neighborhoods, would be free to the end user. Cellnet will partner with two other ISPs to manage access and billing. No taxpayer dollars will be used to build or operate the service. Madison City will become an anchor tenant for some of its applications, and will gradually migrate parts of its network to Cellnet. Deployment will be phased.

Philadelphia, Pennsylvania:

Philadelphia, Pennsylvania — population of approximately 1.5 million; population density of 4,200/sq km, city area of 370 sq km, metropolitan area population more than 5.8 million; major commercial, educational, and cultural center for the nation.

Philadelphia's initial focus was on using wireless technology to address critical issues in the community, including equal and affordable access to broadband and more efficient and effective government services. The City planned to build its own wireless network. The benefits envisioned include lower cost of operations, enhanced public safety and security, and a foundation for growth and competitiveness. Philadelphia's goal was to become the number one wireless city in the world.

The business model lacked the support of all Council members, and some of its initial assumptions came into question. The State of Pennsylvania passed a bill preventing any state municipality from installing a broadband network without an incumbent provider getting right of first refusal. The City subsequently backed down and issued an RFP for the project. It contracted EarthLink, in partnership with Google, to build, own and manage the network. Contract negotiations have been protracted.

Model: Public-Private Partnership:

Initial plans were to adopt a Cooperative Wholesale model, with the City creating a non-profit Organization, Wireless Philadelphia, that would build the network by contracting out to private parties. The City realized it was not equipped to build and manage such an undertaking and that the cost and revenue estimates were questionable. Philadelphia then contracted with EarthLink and Google to fund, deploy and operate a 135 square mile Wi-Fi network.

Google entered the partnership as an anchor tenant, seeking an ad-based revenue stream. Philadelphia will also be an anchor tenant on the network and negotiated low user fees, including discounted rates for a limited number of low income residents. EarthLink will generate revenue from monthly subscription fees and other Internet service providers seeking to resell services to customers. It will finance, build and manage the wireless network, and share revenue with the City of Philadelphia subject to certain conditions. EarthLink is currently viewed as one of the biggest service providers in municipal Wi-Fi, and has been contracted to build and operate Wi-Fi networks in New Orleans, Anaheim and Milpatas, California.

San Francisco, California:

City and County of San Francisco, California — population 798,680; an area of 122 sq km; 6,115 people/sq km (second most densely populated major city in the United States; more than 15 million visitors a year, strong technology (Silicon Valley), biotechnology, biomedical, financial and educational centre.

San Francisco solicited proposals to install, manage and operate a city-wide wireless broadband Internet access network for the purpose of *"increasing broadband availability, spurring economic development, and enhancing local neighbourhoods"*. EarthLink, in a partnership bid with Google, was selected in January 2007 to build the network. As its anchor tenant, Google will provide free Internet access, paid for with revenues generated by serving up ads to users depending on their location and search content. Critics are concerned that the proposal fails to provide adequate privacy safeguards for consumers and that the Wi-Fi signal would not penetrate deep enough into most buildings to enable service without consumers having to buy extra equipment. The agreement allows subscribers to opt out of EarthLink's use of their location information and limits EarthLink's retention of the location data.

Model: Public-Private Partnership:

The City and County of San Francisco contracted with EarthLink to install, manage and operate a city-wide wireless broadband Internet access network and to offer wireless broadband products and services. EarthLink will build the network and offer a fee-based premium service, and Google, as an anchor tenant, will offer free basic service paid for with ad and content revenues generated by way of its capture portal. The system will require a six-month proof of concept to be followed by phased deployment. The technology risk is EarthLink's, which has agreed to keep the network updated to industry standards. EarthLink will provide a variety of services (e.g. Premium, Occasional, Digital Inclusion -including CPE, Roaming and Basic network services). There is an agreement to share a percentage of revenues.

Taipei, Taiwan:

Taipei, Taiwan — population of 2.63 million; average density of 9,700 people/sq km; high computer usage and Internet access rates (88% of households with computers, 84% with Internet access); restricted land area.

City officials believed that to make Taipei competitive as an international metropolis it needed to overcome its geospace constraints by creating a cyber-city and transforming its communications infrastructure into a cyber-metropolis. The vision was to expand and improve services for the municipal government and businesses, improve the quality of life for citizens by keeping them well-informed and make communications fast and accurate. Taipei residents will use the Internet to access government services, hospitals, schools, community organizations and businesses.

Model: Public-Private Partnership:

The City granted a nine-year franchise to Q-ware Systems to build and operate the network. Q-ware committed more than $36 million dollars to the project. A pilot was launched in 2004 to connect 30 subway stations covering about 20 per cent of the population. The second phase deployed 2,000 access points to cover 28 square kilometres, and a third phase deployed more than 4,000 access points covering 134 square kilometres and a population of about 2.3 million. Taipei is an anchor tenant and Q-ware created multi-tiered subscription plans. Subscription rates have been disappointing — 60,000 users registered for the initial free-trial period and only 10 per cent (6,000) have opted for the pay service.

Canadian Cities:

Calgary, Alberta:

Calgary, Alberta — population in excess of 1 million people; encompasses an area of 790 sq km; population density of 1,252/sq km.

In 2003, the City explored the notion of publicly accessible Wi-Fi with a number of technology companies. They formed a project that created four (4) separate hot zones in downtown Calgary: City Hall Atrium, Central Library, Olympic Plaza and Stephen Avenue Walk. It offered the public 60 minutes of free Internet access per day. Interest in the project was short-lived, because of low take rates, minimal benefits, real-estate issues (including location of hardware) and significant support business process requirements and costs. The hot zones were deactivated after six months and the project formally terminated in 2006. Free access was retained in the Central Library, with plans to extend this to all libraries in the city, as part of the City's mandate. Current library plans include allowing University students to access the University of Calgary's resources from the libraries. The City tried some other Wi-Fi initiatives as part of the Business Revitalization Zones (BRZ) and these also generated poor results. At present, the City of Calgary has adopted a hand-off approach because of the lack of a business case, security issues and costs/funding issues. It has left the provisioning of publicly-accessible wireless broadband to commercial ISPs.

Fredericton, New Brunswick:

Fredericton, New Brunswick — population of 51,000 (greater Fredericton 85,000); an area of 121 sq km with a population density of 362/sq km.

In response to shortcomings in the marketplace, Fredericton, backed with commitment support from local businesses, established its own municipally-owned CRTC telecommunications company. The company, e-Novations ComNet Inc., developed Fredericton's own ultra-high speed community Internet network. The network includes seven towers distributed throughout the City, that wirelessly connect to more than 100 access points. These, in turn, are connected to the fibre network backbone and enable affordable, efficient, high-speed connectivity for businesses, government, academic institutions and individuals. The City was able to increase municipal productivity by interconnecting various information technology assets in approximately 20 municipal facilities to create a Municipal Area Network (MAN). Using excess capacity on the network, Fredericton offers free Wi-Fi access to residents through Fred-eZone.

Fredericton's strategy is to differentiate itself from other municipalities in an effort to increase its ability to attract and retain knowledge industries looking for a location that offers an innovative, productive and exciting environment.

Model: Public Utility

The City established a municipally-owned telecommunications company, licensed as a CRTC non-dominant carrier, to build and manage Fredericton's fibre optic network. The initiative is publicly-funded and viewed as municipal infrastructure. The City does not view the Wi-Fi network as stand-alone technology, but as part of its broadband strategy.

Toronto, Ontario

Toronto, Ontario — population of 2.5 million people; encompasses an area of 630 sq km, with a population density of 3,900/sq km; Greater Toronto Area population of 6 million.

Toronto Hydro Corporation, owned by the City of Toronto, operates four wholly-owned affiliates that provide electricity distribution, retail energy services, telecommunications and street lighting. In 2006, Toronto Hydro Telecom Inc. announced plans to launch a city-wide Wi-Fi wireless network in the downtown core. The new Wi-Fi service complements Toronto Hydro Telecom's existing fibre optic business, which has been in operation since 1995. The intent is to provide coverage in downtown Toronto's dead zones by installing access points on existing street lighting poles to provide seamless access to the Internet from any location within the Wi-Fi mesh zone. The network will be implemented in five stages, with the first completed phase covering six square kilometres.

Model: Public Utility

The initiative is funded by Toronto Hydro Telecom, a CRTC non-dominant carrier) an affiliate of the city-owned Toronto Hydro Corporation. The initiative is an extension of its existing telecom business, and was originally linked to Toronto Hydro's desire to have a city-wide network that can communicate with a smart meters initiative. The Wi-Fi network utilizes the company's existing fibre optic network. For the first six months, the service in the initial pilot area was free of charge. Four packages are available and competitively priced with existing competitors. There are three price points — $10 for a day plan, $29 for a monthly subscription or $5 per hour. While this initiative aligns with the City of Toronto's desire to wirelessly enable the City and derive productivity benefits for its field work force, the initiative is also an opportunity to generate some additional revenue. The coverage is currently limited to six square kilometres in the downtown area.

Vancouver, BC:

Vancouver, BC — population is 583,000 in Vancouver proper, and 2,208,300 (2005 estimate) in the greater metropolitan area; area of 115 sq km (metro area 2880 sq km) with a population density of 5,250 per sq km.

In 2006, the City Council requested a study be undertaken on the desirability and options of pursuing a free or low-cost high speed wireless municipal network for the City of Vancouver. Council was presented with a report prepared by city staff which concluded the City was relatively well served with broadband access, the current Wi-Fi technology set would likely not deliver all requirements of the vision economically and that the competitive private sector would eventually deliver the wireless city vision.

B

Appendix B — Business Models

A variety of business models are evident in Wi-Fi deployments. These models reflect decisions about who pays for the cost of building a network, the source of funding for ongoing operations and maintenance costs and, most importantly, the purpose of the network: the users, the requirements and the benefits being sought. These decisions determine the technology choice and preferred operating model best suited to providing the required customer care, network operations, management requirements and the amount of risk a city is willing to assume. Research indicates that municipalities and other entities that have implemented wireless Internet networks have most commonly used one or more of the following general operating models (FTC Staff Report, Sept 2006, — Municipal Provision of Wireless Internet):

Non-Profit/Community Model:

Under this model, a non-profit organization is formed or an existing organization volunteers to organize, fund, deploy and maintain a wireless Internet network, sometimes at no charge to users. The non-profit may raise funds from charitable donations or grants, or secure loans from private institutions and the municipality. The non-profit may negotiate with a municipality for right-of-way access to streetlights, traffic lights or buildings. It may contract with a private telecommunication company to design and operate certain aspects of the network. The non-profit acts as a catalyst to encourage the organic build-out of a Wi-Fi network. Typically these networks are not ubiquitous, and limited service is provided only to a particular space or attraction, such as a park or museum. This is essentially a grassroots initiative, and a municipality would have little, if any, involvement.

Association/Cooperative Model:

In an Association/Cooperative model, local business and other private community groups pool resources to design, fund, implement and maintain their own wireless Internet network. Like a conventional private business model, the municipality's involvement in these activities is minimal, and its main role is to act as a catalyst and perhaps provide rights-of-way access for installation of wireless equipment.

Contracting-Out Model:

In this model, a municipality contracts with one or more private telecommunication companies to design, fund, implement and maintain a wireless network. Generally, the municipality's involvement in these activities is minimal, and its main role is often to provide right-of-way access for installation of wireless antennas. Such an arrangement may be structured in the form of a franchise granted by the municipality. The private provider typically charges most subscribers a market-based rate. They may act as a wholesaler and may also partner with other organizations to provide a revenue stream for the network. The municipality, however, may negotiate with the private provider to regulate rates, secure special rates for low-income persons or obtain a discounted rate for itself in exchange for serving as an anchor tenant of the network.

Public-Private Partnership Model:

In this model, a municipality is actively involved in designing, funding, implementing and/or maintaining the network. One or more of these functions, however, is contracted out to the private partner. The municipality may negotiate with a partner to regulate rates, including setting lower rates for low-income persons, or some other beneficial arrangement. In addition, access to this type of network may be resold on a **wholesale** basis to other private ISPs. Where there are regulatory constraints (particularly in the US) preventing municipal governments from entering the telecommunications business, the city may set up an arms-length business or non-profit organization to drive these initiatives in partnership with other ISPs.

Municipal (Internal Use) Model:

The municipal model is deployed to meet a city's internal wireless broadband needs. The municipality is primarily responsible for designing, funding, implementing and maintaining the network. Although some aspects of creating and operating the network may be contracted out to private parties, the municipality remains principally responsible for the network. A variation of the **Municipal Model** is the scenario where a current public utility, owned by the City, leverages its broadband network and competes in the marketplace by providing affordable wireless broadband service directly to businesses and residents, managing subscriptions and billings as it does for municipal water and electricity. As a further variant, a municipality or public utility may segregate traffic on its network so excess capacity can be leased to service providers, (under a Cooperative Wholesale business model) who then offer service directly to the public. The service providers operate and manage the public portion of the network, including marketing and billing. This model generates revenue to the city from the wholesale service providers.

Government Funded Model:

In this model, the government recognizes a need for improved Internet access for citizens and establishes programs to help improve broadband access, affordability and adoption rates. Improved access is utilized to expand e-commerce, e-learning, e-government and telemedicine — all of which are anticipated to create better jobs, improve government responsiveness and greater opportunities to improve the quality of life for citizens. Typically governments work with communities and business leaders to help the project succeed. The initial phases of Alberta's SuperNet are an example of this model.

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