

# Seattle Wi-Fi Pilot Project

## Evaluation Report



November 2006



**City of Seattle Department of Information Technology**

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## I. Introduction

This report presents an evaluation of the Seattle Wi-Fi pilot project after 17 months of service. The City of Seattle's free municipal wi-fi service was launched in May of 2005. It was provided with a focus on public access rather than as a pilot of internal city applications of wi-fi. Service has been provided in two business districts, four downtown parks and the lobby of city hall. This pilot project has been operated by the Department of Information Technology (DoIT) in partnership with the City's Office of Economic Development, Department of Neighborhoods, and Department of Parks and Recreation along with community partners, University of Washington, University District Chamber of Commerce, Rainier Valley Chamber of Commerce, and Columbia City Business Association, as well as co-sponsors Homesight and Atlantic Street Center. Service has been delivered through wireless access points mounted on city utility poles with an additional four test repeaters (customer premise equipment) placed inside a library, cultural center, book store and restaurant.<sup>1</sup>

Data for this evaluation came primarily from usage statistics and the surveying of users and businesses. It is not a comparative report of Seattle to other systems and trends in municipal wi-fi, though those were taken into account while developing and implementing this evaluation.

In addition to this wi-fi pilot project, the city has been working on a complementary project to investigate the feasibility of citywide fiber to the premises (home, business, organization, etc), which may include a wireless component. For more information, see [www.seattle.gov/broadband](http://www.seattle.gov/broadband).

## II. Project goals

The Seattle Wi-Fi pilot project has focused on public access rather than testing use of applications for internal city use. The goals of the city's wi-fi pilot project are to:

1. Enhance business revenues and district economic viability by
  - a. Attracting more customers and increasing purchases
  - b. Using the wi-fi web pages to market local products and services
2. Increase productivity and sustainability of small businesses by
  - a. Increasing access to online resources
  - b. Lowering Internet costs
3. Increase the use of Seattle.gov.
4. Learn the technical requirements for municipal wi-fi deployment.
5. Encourage mixed use and greater public safety in the parks.

For the University of Washington, an additional goal was to provide off-campus access to information for students, staff and others associated with the university. While not a primary goal, there was also interest in whether the service would provide an option for residents who might not be able to afford high bandwidth Internet service.

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<sup>1</sup> See technical report section for more discussion.

### III. Project Background

The decision to conduct a Seattle wi-fi pilot project was the result of a number of interests and opportunities that developed over the course of 2003-2005. These included:

- Mayor and City Council interest in wi-fi as part of their strategy to maintain Seattle's identity as an attractive and forward thinking city, as well one which strongly promotes access to information.
- Citizen-expressed interest in free or low-cost ubiquitous Internet access.
- Interest in testing wi-fi as a tool in efforts underway to enhance safety and programming in in downtown parks; this effort was led by by the Downtown Seattle Association with the Parks Department.
- Desire to use wi-fi for fostering economic development in the Rainier Valley, proposed by the Rainier Chamber of Commerce and expressed as part of the community's Southeast Seattle Action Agenda.
- Department of Information Technology interest in exploring municipal uses of wi-fi for internal city communications and external customer services.
- Interest from the University of Washington in serving staff and students off-campus.
- The growing development of wi-fi technology capabilities and interest in wi-fi applications.
- The deployment of municipal wi-fi systems elsewhere.

The Department of Information Technology (DoIT) began discussions with the Office of Economic Development in 2004 about the potential opportunities of wi-fi. DoIT had also begun some testing of wi-fi equipment.

A small pilot in Westlake Park was launched in 2004 by Metropolitan Improvement District/Downtown Seattle Association (DSA), with funds from the City's Technology Matching Fund, donated Internet service from a DSA member, and an access point mounted in a member's building. DSA determined that they did not have capacity or interest in actually operating a wi-fi system and left it to the City to provide wireless in the nearby Westlake park/plaza.

In 2004, the University of Washington (UW) stepped forward with an offer to contribute Internet service for a five year period. The UW support, combined with funds allocated from the Office of Economic Development and Department of Information Technology, enabled the project to commence. The city then worked with the University District (UDistrict) Chamber of Commerce, of which the UW is a member, to define the service area in the UDistrict.

In the Rainer Valley, the city, Rainier Chamber of Commerce and other participants in the Southeast Seattle action planning effort selected Columbia City as the location for the pilot, based on its business density, interest, and position as a struggling, but improving area.

The four downtown parks, (Freeway, Occidental, Victor Steinbrueck and Westlake), were selected by the Department of Information Technology and Department of Parks and Recreation for two reasons: 1) the city was working on redeveloping these sites to increase safety and diversity of use and users; and 2) their locations made it possible to reach via a wireless link from the Seattle Municipal Tower network facilities.

The business associations offered to contribute to the marketing and maintenance costs. In the Rainier Valley, two non-profit service organizations, Homesight and the Atlantic Street Center, stepped forward to contribute towards the cost of Internet service for that area.

The system was designed, installed and has been maintained by the Department of Information Technology. D-Link has been the primary equipment vendor and provided technical assistance.

A formal launch of the project was held at the Wellington Restaurant in Columbia City on May 18, 2005 with a subsequent first promotion at the annual UDistrict Street Fair a few weeks later. The system was launched with the identification (SSID) of “seattlewifi.”



As the system became operational we encountered equipment, software and interference issues. An independent wi-fi systems contractor, ACJ Technology Solutions, was retained by D-Link and then in September 2005 by the City of Seattle to provide development and maintenance assistance. Throughout the pilot project there were a number of upgrades and system changes made in order to provide more reliable service.



Street signs identifying the hotspot zones and sponsors were installed in the two business districts. In addition to street signs, promotional postcards were distributed in each business district. Marketing interest has been greatest in the Columbia City business district, where over 2000 cards have been distributed. In August 2006, the city registered Seattle Wi-Fi with eight online hotspot registries. To promote the service, a team from the Department of Information Technology and friends marched under the Seattle Wi-Fi banner in the 2006 Rainier Valley Heritage Parade.

## IV. Technical Infrastructure Overview

Seattle Wi-Fi has provided free 802.11b and g wireless access in the University and Columbia City business districts, the City Hall lobby, and four downtown parks (Steinbrueck, Occidental, Westlake, and upper Freeway). The access points are attached to light poles with power drawn through attachments in the light sensors at the top of the streetlights. External antennas are connected to the access points and mounted on the poles. This is a straight wi-fi system rather than mesh design, selected because of cost and a target of corridor coverage rather than area coverage for the business districts.

The system is distributed into three communication zones with a D-Link DSA-3100 gateway for each of the two business districts and one serving the combined downtown parks and city hall. The initial gateway configuration enabled the city to provide three separate log-in pages, one for each zone. Access points are D-Link DWL-7700AP Wireless AG Outdoor AP/Bridges. Fiber optic provides the backbone between the gateway headend and the systems at Columbia City and at City Hall. A 7700

links the University District access points to the fiber backbone in the UDistrict. Access points are installed on alternating sides of the street approximately one block apart. The business district deployments are configured with 7700's also serving as bridges to relay the signal in a linear path down the street corridors. In each park there is currently one access point provided, with a 7700 serving as a wireless link back to the Seattle Municipal Tower's network center.

### **Internet service**

Internet has been provided via the Northwest Gigapop and managed by the University of Washington. Bandwidth capacity is currently 5 Megabits per second from the UW and has been sufficient for demand.

### **Coverage**

Coverage is provided on the street with some penetration of buildings. In the UDistrict, coverage extends roughly from 42nd St. NE to between 45<sup>th</sup> and 47<sup>th</sup> on University Ave and along 45th from University Ave to 12th. Initial coverage to 47th was reduced with the temporary removal of a pole as a result of construction. In Columbia City, coverage extends along Rainier Ave. from Alaska street south to near Dawson Street. Three parks (Steinbrueck, Occidental and Westlake) are generally covered. For Freeway Park, the single access point is located on an adjoining street and covers a section of the upper park but not the lower park due to the park's topography. City Hall has one access point in the lobby covering that area and a portion of the Council chambers. (See Appendix 2 for business district coverage maps)

### **Log-in and landing pages**

Each gateway is configured with a log-in "splash" page containing identification of Seattle Wi-Fi and sponsor logos, terms of use and contact information. After logging in, users' web browsers are automatically directed to a landing page to start. The landing pages have live links to the sponsors. In the case of the University District, the Chamber of Commerce developed a custom page with advertising, Chamber events and information and the sponsor logos (with the city link at the bottom). (See Appendix 3 and 4 for splash and landing pages)

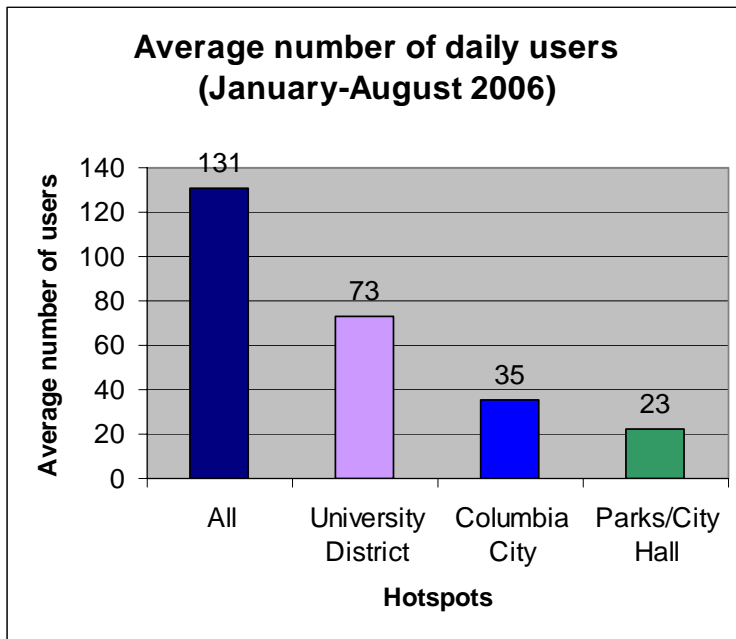
## **V. Who is using Seattle Wi-Fi?**

**There were 9,704 unique users on Seattle Wi-Fi in the first eight months of 2006 and more than 12,000 by the end of November.**<sup>2</sup> Through August 2006, the University District business district had 5,609 users (57%), Columbia City business district had 1,605 users (17%), and Parks/City Hall totaled 2,490 users (26%).

The numbers of users per day averaged 131 with a high in August of 172. In October, the average had climbed to 191 users per day.

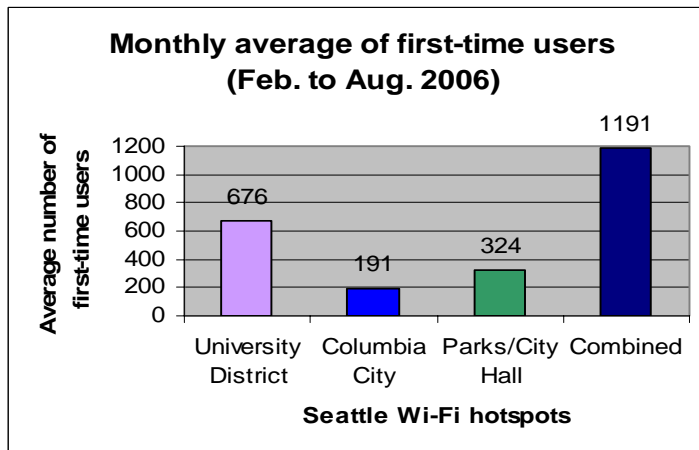
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<sup>2</sup> As defined by distinct computer MAC addresses. It is possible one person used more than one computer or more than one person used a single computer..



**New users**

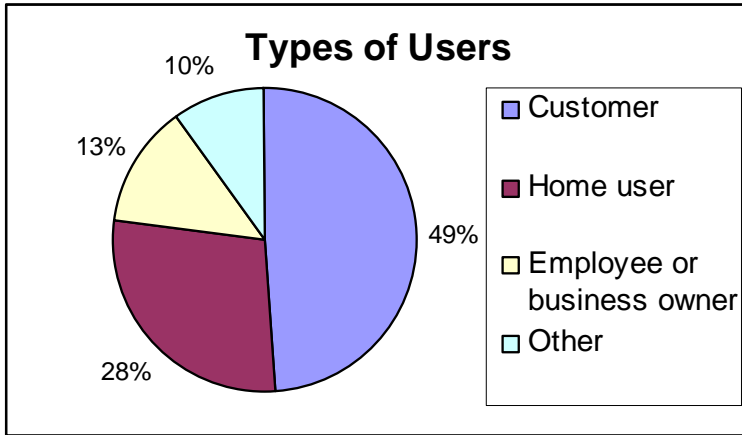
**Seattle Wi-Fi is averaging almost 1,200 first-time users per month.**<sup>3</sup> On average, new users accounted for 68% of all users each month. Columbia City has shown the largest percentage of repeat users (57%). Of all the survey respondents, a little over one-fourth (28%) were using Seattle Wi-Fi for the first time and the same number had been using it for more than 6 months; 43% had used it more than once but less than 6 months.



<sup>3</sup> Based on the period February-August, 2006. January was not included since this was the baseline month where previous users were added to the database.

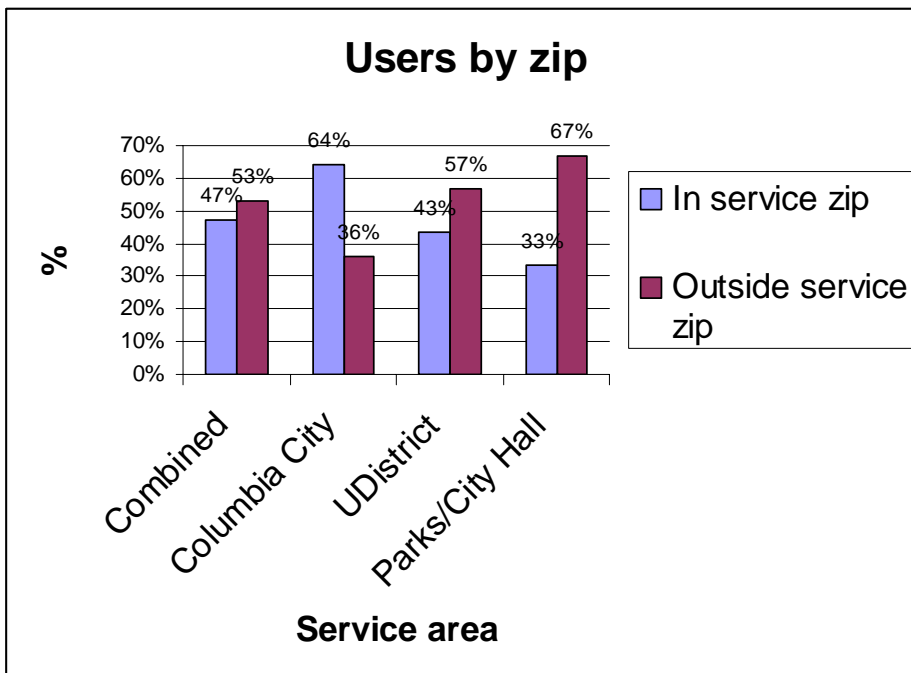
### Types of users

From the online user survey we found that the almost half of those responding were customers (49%), followed by home users (just over a quarter) and employees or business owners accounted for 13% of users. About 10% self-identified as “other,” describing themselves as students, visitors or tourists, or in a variety of other ways, including combined customers and residents, visiting scholar, library patron or traveling users.



### Local users

Overall, slightly more than half of respondents identified themselves as from the zip code in that service area, though there were differences between the service areas. Columbia City had a higher percentage of local users. Parks/City Hall and the UDistrict showed greater percentages of visiting users.



## Time of use

The service has been used most during business hours on the weekdays, especially in the mid to late afternoon.

## Marketing and how users find Seattle Wi-Fi

Street signs were placed in both business districts and promotional postcards distributed at the business association meetings and to some of the stores. The cards were more widely distributed through the business association in Columbia City. Of the businesses surveyed, over half felt that there is not yet enough awareness of the service. A third of the businesses surveyed in the University District did not even know about Seattle Wi-Fi.

Half of the user survey respondents found Seattle Wi-Fi when their computer connected to the signal. However, in Columbia city the most common way they found out was via the street signs located in the coverage area.

Overall, thirty percent of all respondents said they found Seattle Wi-Fi via street signs. Other ways that users found out about Seattle Wi-Fi are from other users (16%), the media (14%), wi-fi hotspot websites (5%), city's website (4%), and other sources (6%). Columbia City respondents were also more likely to cite the city's web site and business association meetings as sources.

For customers, street signs and hotspot web sites were slightly more likely sources of learning about Seattle Wi-Fi than they were for residents and business owners.



## VI. Business impact

Businesses were asked whether Seattle Wi-Fi has increased their revenues and whether it has increased customers. Conversely, users were asked whether Seattle Wi-Fi contributed to their visiting the business district and stores. **The results show that Seattle Wi-Fi has clearly added a valued service to the business districts and has increased revenue and customers for some businesses.** There is an interesting contrast between businesses' reporting and wi-fi users' responses. While a number of businesses didn't know whether it had an impact on revenue and customers, we found a high number of users saying wi-fi was a factor in them coming to the businesses.<sup>4</sup>

About one-quarter of businesses surveyed thought it had increased revenues, with Columbia City being much more positive about revenue increases (36% in Columbia City vs. 8% in the UDistrict). The majority of businesses were either uncertain or said there had been no difference in revenues. Six businesses surveyed (14%) reported an increase in customers due to Seattle Wi-Fi. Again, Columbia City was more positive about this than the UDistrict.

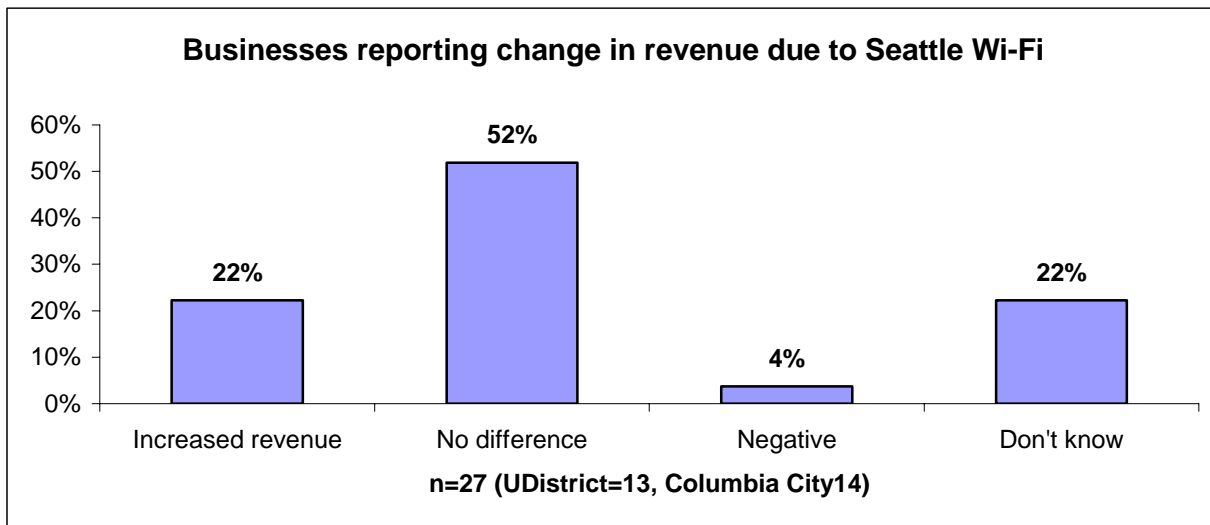
While not widespread, the reported customer and revenue increases are still significant. The greater positive impact in Columbia City may be in part because it was the area with the least amount of wi-fi

<sup>4</sup> The customers' perspective is discussed in section VII, User Impact.  
Seattle Wi-Fi Evaluation; [www.seattle.gov/wifi](http://www.seattle.gov/wifi)

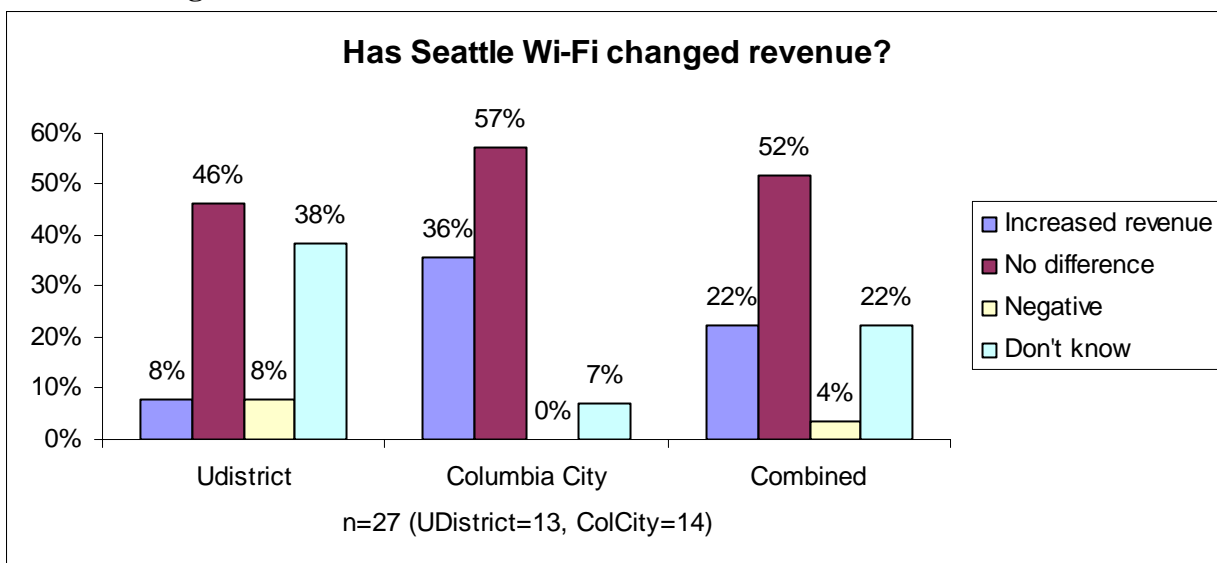
previously provided and where there was the most marketing.<sup>5</sup> We also found that there is strong support for wi-fi regardless of whether or not the business has seen a revenue increase.

There was a fair amount of uncertainty about the wi-fi impact (by approximately one fourth of businesses interviewed). Columbia City merchants were clearer about their perception of whether it had increased revenues, though altogether about one-quarter were not certain. One business indicated an ad on the UDistrict wi-fi login page brought customers to their business. Another in the University District who provides computer terminals thought wi-fi had decreased revenues. Only one of 30 businesses said non-paying customers use the wi-fi.

**Revenue change: Combined business districts**

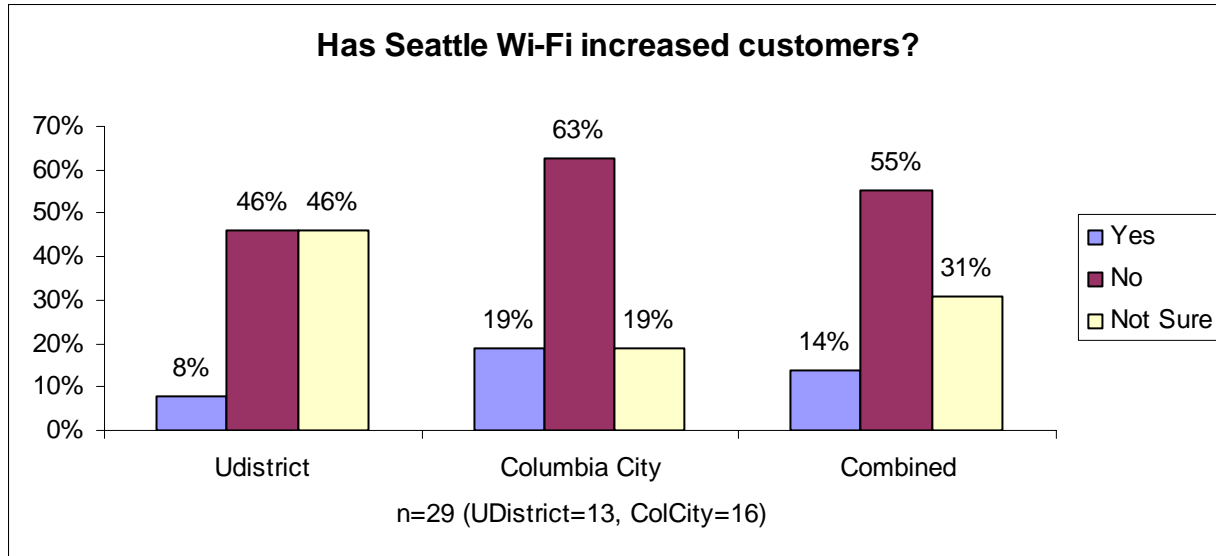


**Revenue change: For each business district**



<sup>5</sup> In the Columbia City service area, the business association and owners took an active role in distributing promotional postcards. In Columbia City we found one coffee shop with commercial wi-fi, one former wi-fi site (discontinued after the business was sold), and one site where the owner was unaware that he had wi-fi set up.

**Customer change: For each business district**



**Managing the experience**

Wi-fi appears to generally enhance the environment, but businesses expressed a need to manage use in their premise. Businesses commented that they felt wi-fi enhanced users’ experiences and also that customers stayed longer as a result. Of all respondents, almost a quarter (23%) said they did not know if the length of stay had been affected. Of those who commented on wi-fi’s effect on customer length of stay, 40% said customers stayed a little longer, 40% said they stayed a lot longer and 20% said they stayed the same length of time. A couple of restaurants expressed some concern over the potential for lingering at meal times when the businesses rely on turnover and wanted to discuss how to manage that traffic.

**Business employee and owner comments on the wi-fi experience:**

“It enhances the customer experience; it gives them an extra appreciation for the business.”

“We would be interested in having a repeater but we would like to turn it off during busy periods in order to keep table turnover around 45 minutes.”

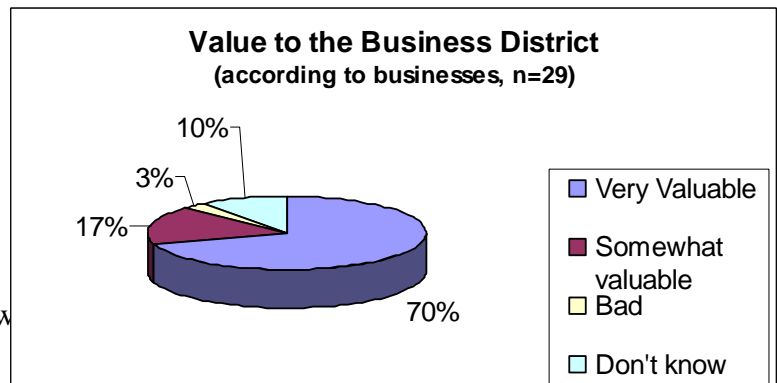
**Seattle Wi-Fi serves as a marketing tool.**

**Seattle Wi-Fi is being used to promote the neighborhoods and business districts.** For example, a condominium development in Columbia City mentions free Seattle Wi-Fi in the business district as a benefit of residence. Also, a non-profit arts organization in the Rainier Valley Cultural Center lists Seattle Wi-Fi as a benefit for those renting and using the space for events at the building.

**Overall, businesses strongly support Seattle Wi-Fi and want to see it continued in the district.**

Seventy percent of businesses surveyed believe wi-fi is very valuable to the business district and an additional 17% see it as somewhat valuable.

Seattle Wi-Fi Evaluation; [www.seattle.gov/w](http://www.seattle.gov/w)



Ninety percent of businesses surveyed would like to see Seattle Wi-Fi continue, with support even among those who have provided other wi-fi. Two respondents didn't have an opinion and only one would like to see it stopped. The University District Chamber of Commerce director indicated that there had been concern at first among businesses in the University District who already had wi-fi. This does not appear to have become a problem and in fact we found support among businesses with one exception. The manager of a chain coffee store offering paid wi-fi in Columbia City expressed appreciation for Seattle Wi-Fi, since it enables her to add more value to the store, offering an option for customers who otherwise would not purchase their commercial wi-fi.

**Owner and employee comments on overall impact:**

"It helps to establish a community. It's like a coffehouse culture but with a laptop".

"Columbia City needs little pushes to help it along. This is one of them. You should have it everywhere in Seattle."

### ***Conducting business using Seattle Wi-Fi***

Some businesses are using Seattle Wi-Fi to conduct business and for a few it serves as their only Internet access. Of the twenty-nine businesses surveyed, five use Seattle Wi-Fi to conduct business. For three businesses, it was their only Internet access. The actual number is likely larger, given that five of the twenty-eight (18%) employees and business owners completing the online user survey indicated that wi-fi was their only Internet access.

**Seattle Wi-Fi is a complement more than a primary Internet connection for most businesses.**

It is being used by employees and business owners, but provides a service primarily for customers. For most businesses, it has not replaced other Internet connections. However, it is the only access for a small number of businesses and employees. As an example of its use as a secondary connection, one business owner uses their laptop in their restaurant at times instead of sitting in the office.

## **VII. User Impacts**

**Customers said Seattle Wi-Fi businesses are destination locations.**

From the wi-fi user perspective, having Seattle Wi-Fi was definitely a contributing factor to their use of the business district and specific businesses.

Two-thirds said yes when asked whether Seattle Wi-Fi contributed to their coming to the area that day. (This was 64% overall, 69.3% for customers and others [non-resident or non-business owners and employees]).

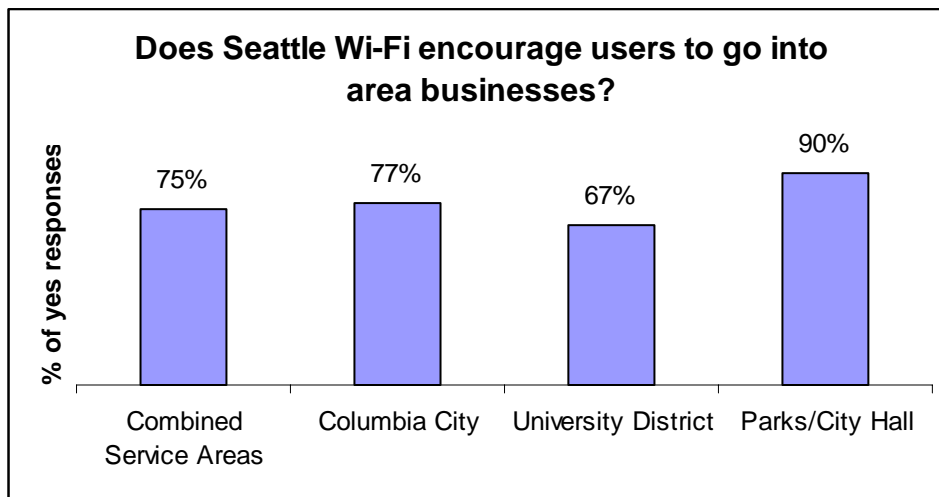
**User comments:**

"If it were not for this publicly provided WI-FI, I would not have frequented Cafe Umbria. I spend an average of \$20 a day there." – User in Occidental Park hotspot

"It makes casual business meetings possible in local restaurants." - Columbia City User

**Seattle Wi-Fi encouraged users to go to the local business.**

Three-quarters of the users said that Seattle Wi-Fi encouraged them to go into a business in the area. (This was 74.8% overall, 78% for customers and others.). Parks/City Hall users reported a higher level of encouragement from Wi-Fi, but the cause of the higher percentage is uncertain.



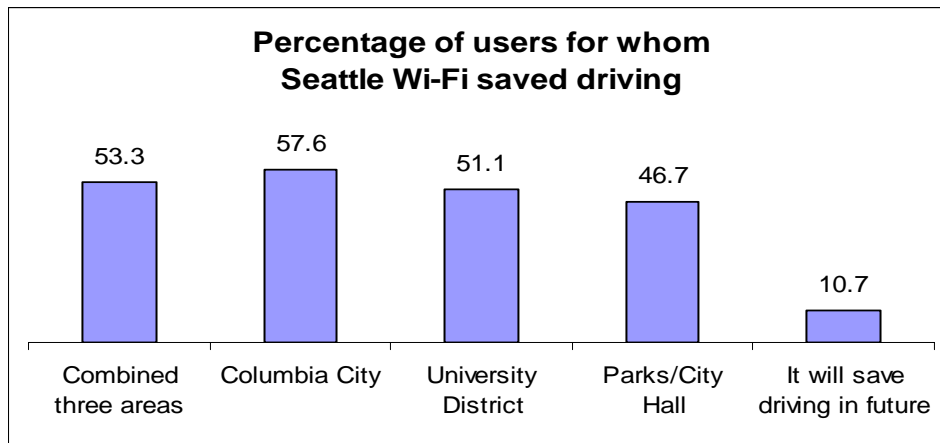
Users also commented that it increases the likelihood they will go into multiple shops. Home workers are utilizing it to work outside the home in the business district.

**Seattle Wi-Fi has improved bandwidth for some users and for some, it is their only access.**

User survey responses indicate that wi-fi does appear to improve bandwidth for a number of users. Overall, sixty-four percent of respondents have high speed Internet access other than wi-fi (via fiber, cable, dsl or other source). There were 24 respondents who indicated that wi-fi was their only source of Internet access. Eighteen respondents (8.4%) have only dial-up in addition to wi-fi and thirty users (14%) replied they have no other access than Seattle Wi-Fi. Of these, just over half (16, 53%) were home users of Seattle Wi-Fi and five were employees or business owners. Of those with dial-up, half were also home users.

**Seattle Wi-Fi saves time, gas and road congestion.**

Over half the users in the survey (53.3%) answered that the presence of Seattle Wi-Fi had saved them driving. An additional 23 users (10.3%) said that it will save them driving in the future now that they know about Seattle Wi-Fi; two-thirds (69.5%) of these were first time users.



### Expectations about coverage and service satisfaction

We found that it is very important to be clear about where users can connect. **Interior (customer premise) coverage is a large technical design issue and effects public perception about service quality.** In the two business districts, just over half expected interior business coverage. There was less street and open space expectations in Columbia City than the other two areas. (Columbia City 33% vs. University 42% and Parks/City Hall at 47%). A quarter of respondents in Columbia City and the UDistrict expected coverage more than a half block into the surrounding areas, with the University District responses being slightly lower. Slightly more than a quarter of all respondents had no particular coverage expectations. Not surprisingly, the Parks/City Hall responses had somewhat lower expectations for inside business coverage and higher expectations for street and open space coverage.

The system had some significant early technical issues, so we wanted to see whether users were satisfied with service, especially since technical improvements were made. We found that most users are satisfied with the service. In general, users rated their experience logging on to Seattle Wi-Fi as the same or better than other wi-fi systems. Around 40% rated it the same, 44% more rated it better or much better (with 16% as much better), and approximately 14% rated it worse.

Some had difficulty connecting but this is less of an issue recently and for new users<sup>6</sup> Overall, half the respondents had difficulty connecting. However, the number was only half as much for newer users, which may be a reflection of service upgrades made to the system. Business owners and employees, followed by home users were the most likely to experience difficulty.

In the last 3 months since system improvements were made, users' experience overall has been positive, though there is some room for improvement. Three-quarters of users rated their experience with Seattle Wi-Fi in the past 3 months as good or excellent (52% good and 21% excellent). One-fifth have only had a lower "fair" experience.

### Users placed a high value on Seattle Wi-Fi.

**Almost 95% of respondents felt that it was valuable to have wi-fi provided by the city in their area.** (81% said very valuable and 13.6% said somewhat valuable).<sup>7</sup> This number was somewhat

<sup>6</sup> The connecting challenges faced by users are described in more detail in the technical section of this report.

<sup>7</sup> 2.8% said not valuable, 1.4 were neutral and 1.4% did not know. n=214

smaller in the business districts than in Parks/City Hall, where all respondents selected very valuable or somewhat valuable. There was not a significant difference in answers by type of user.

## VIII. Content on the web portal

### Users expressed interest in local content that could be delivered on the starting pages.

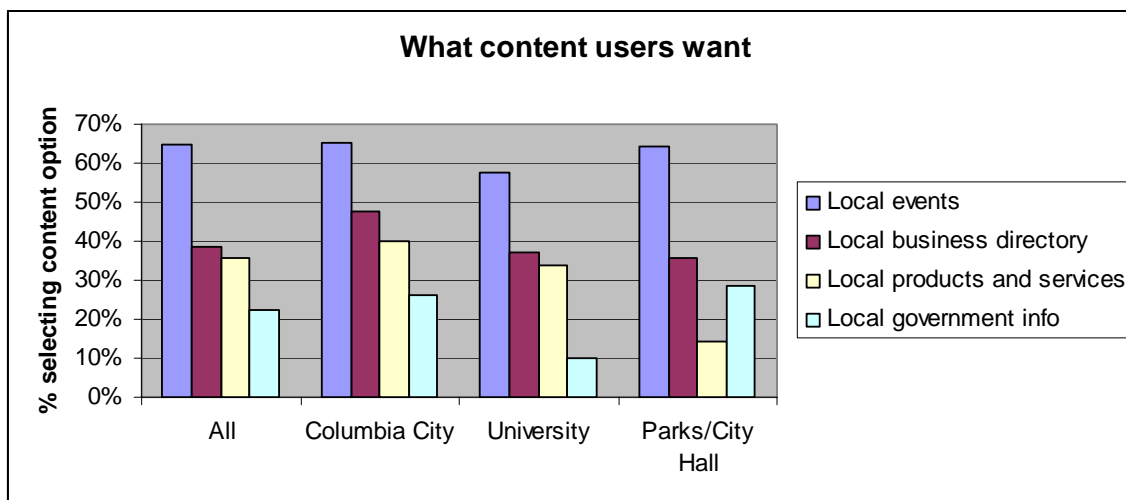
When users log-in their web browser is directed to a specific page. Columbia City users are directed to a landing page with sponsor links. UDistrict users have been provided with a page run by the chamber of commerce that includes sponsor links as well as local ads and business information. The Columbia City/Rainier Valley page has been simpler with only sponsor links. In the parks and City Hall, they are directed right to the city’s home page. The survey results indicated these starting pages could be used to a greater advantage. (See Appendix 4 for the landing pages)

Users were asked if they wanted specific information after connecting with Seattle Wi-Fi. Almost two-thirds wanted local event information, followed by a business directory, local product and services, and government information.<sup>8</sup> Also cited as desirable content were neighborhood information, maps, education resources, and wi-fi help materials. Only 6% indicated that they only wanted to go to their own area of interest and wanted no content presented.

Businesses have expressed some concern that a national wi-fi provider inserting advertising could supersede promotion of local products and services (e.g. the local book or shoe store).

### Seattle Wi-Fi increased the use of Seattle.gov.

There were 10,494 page views of the seattle.gov home page as a result of Seattle Wi-Fi in the first eight months of 2006. The next most popular sections of the city’s web site were citizen services (transportation, utilities, city service directories, etc.), personnel and employment information, parks, planning and development, and city council information.



<sup>8</sup> There were small, but not significant differences between types of users.

## IX. Support for Continuing Seattle Wi-Fi

There was strong support from businesses, users and even non-users in favor of continuing Seattle Wi-Fi. Even those businesses who did not perceive it as having increased their customers or revenue still saw the service as beneficial to the districts and would like it continued. Ninety percent (90%) of businesses said yes to continuing Seattle Wi-Fi. Of the online user respondents, there was an almost unanimous response that users would like to see the service continue, with 98.5% saying yes.<sup>9</sup> Six of the nine non-users surveyed also said Seattle Wi-Fi is very valuable to the business district.

### Comments from users:

"Thank you Seattle! You are very friendly to techie visitors!".

"So far I have loved having Seattle Wi-Fi. I was a student at the U and it helped to connect instead of going to the library. Now that I've graduated it's helped since I no longer have time or a log-in on the campus."

## X. Digital Inclusion and Wi-fi Literacy

**The Seattle Wi-Fi pilot project brought to the forefront four areas where equity is of concern and where there are opportunities for greater digital inclusion.**

These include: the cost and availability of the Internet connectivity, access to equipment, technology literacy and content development. The pilot project did not address these issues in any concerted way, though wi-fi exposure in Columbia City and the other areas fostered some education and increased technology awareness.

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"It's been an asset. It doesn't tie up my phone line. It's probably helping low-income people who can't afford Internet access otherwise."

- Survey respondent

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### Connectivity

Wi-fi can bring broadband and competitive choice to an area. Seattle Wi-Fi enabled new connectivity for some residents, either providing a first Internet connection or enabling upgrading to broadband. Wi-fi service, particularly in a case like Seattle Wi-Fi with subsidized free service, opens the door for those where cost is a barrier to entry. We did not survey users about cost, but the effectiveness of wi-fi connectivity as a means of closing the digital divide for low-income residents, businesses and non-profit organizations could go down as subscriber fees increase.

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<sup>9</sup> Of 214 online respondents, 2 users in Columbia City said no and one respondent was not sure. Of the business interviews, one in the UDistrict said no and two businesses were not sure or had no opinion.

Wi-Fi was a valued connection option. Even in our limited service area, we found sites that were considered to be non-serviceable by the cable broadband company. Decisions and the design of wi-fi systems also need to be aware of who's covered by what broadband services, who's left out of full coverage and how the design and pricing rationale meet public interests. Seattle Wi-Fi designers had to determine the scope and pilot coverage areas based on finances and project goals. The Columbia City/Rainier Valley area was chosen to reach a more diverse community than the UDistrict would. As we worked with the Rainier Valley leaders to selecting a pilot site, a denser area was selected over business district areas where businesses were more spread out, there were fewer restaurants and there was a less organized business constituency to work with. The impact and scope of these potential exclusions would be worth evaluating for broader deployments as well.

### **Access to equipment**

This pilot project has not addressed the issue of equipment haves and have-nots. This issue is greatest in the Columbia City/Rainier Valley area which has a higher technology underserved community (as correlated with income, education, age, and ethnicity<sup>10</sup>). The equipment issue is one for both residents and businesses. In surveying we found small and immigrant operated businesses with no computer and no knowledge of what equipment is required to use wi-fi. Some business owners expressed an interest in purchasing laptops and/or wi-fi cards; asking us for advice during the evaluation interviews.

### **Literacy**

A literacy strategy is critical to ensuring equity in wi-fi utilization. We found a vast gulf of knowledge with the business district owners and employees as well as customers of the area. While we don't have subjective data on this, city staff found businesses that knew so little about wi-fi and/or how to use computers in their businesses that they faced a large barrier in using wi-fi or in encouraging others to do so. Through the course of the project, we have been able to provide some assistance to increase the skill level of businesses and customers through our presence on the project. Similarly, one positive benefit of the wi-fi project we observed was customers helping each other and the businesses with wi-fi.

### **Content**

Localized content is an area where there is great opportunity, but which needs local capacity building. The pilot project only slightly touched upon the localized content that could be provided to wi-fi customers. The business associations had online directories of their members, but there are still a number of businesses without listed websites and with limited information about their products and hours. Not all businesses in the wi-fi service areas are business association members and hence not necessarily in their directories. To fully capitalize on potential content, assistance would be needed to gather and post local product, services and events information as well as ensure content is up to date. This local content also includes neighborhood civic, school, human services, cultural, arts, and faith-based community information.

## **XI. Technical Operations**

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<sup>10</sup> For more information, see Seattle Information Technology Indicators reports at [www.seattle.gov/tech/indicators](http://www.seattle.gov/tech/indicators)  
Seattle Wi-Fi Evaluation; [www.seattle.gov/wifi](http://www.seattle.gov/wifi)

Overall, the pilot project has had some problems, but has been successful in delivering connectivity to users. The system was built and delivered with minimum staff and while equipment was rapidly evolving. The pilot project provided a trial ground, with lots of learning along with some frustrating technical challenges for staff and for customers.

### **User configuration & bandwidth management**

The system gateways allow a maximum of 50 concurrent users (requesting data simultaneously at a given moment) in each service area (Parks/City Hall, or the UDistrict, or Columbia City). Since the project was started, we have not reached this limit. User sessions have been limited to two hours, with users allowed to log-on again after that. An idle time limit of 10 minutes was set, which automatically dropped a user from the system if there was no activity for that time. There were a few comments in user surveys about the inactivity time being too short. For instance, one user filling out a job application lost the connection while they were completing the form. The log-in and inactivity limits are set by DoIT's system operator; this is being adjusted to increase the inactivity limit and will be monitored to ensure it doesn't restrict other users from logging-in.

### **Reliability and interference**

Our pilot project found that coverage and wi-fi reliability is not as robust as touted. The system saw a number of unanticipated technical issues, particularly in the first nine months. The primary symptom was locking up of access points, resulting in partial system outages. This was found to be the result of multiple causes, including faulty chips in the hardware, software bugs, interference and user created challenges (see more on this below). D-Link made a significant effort to work with the city in solving these problems and replacing equipment at their expense. Greg Skinner of ACJ Technology Solutions, a local wi-fi contractor initially retained by D-Link, assisted the city and D-Link in identifying and solving system issues; he was subsequently retained by the city to continue to maintain and enhance system performance. His assistance has been critical to the project's success. D-Link access points have been replaced and the firmware upgraded to a point where they are relatively stable.

There were also outages in the Proxim Ethernet bridges. To increase reliability, Columbia City's link was replaced with a fiber connection and the UDistrict system was upgraded. The new Proxim equipment also improved system management capacity.

### **The megaphone effect, coverage and connection challenges**

The limitations of wi-fi's ability to penetrate vs. user expectations of coverage have been a significant challenge, complicated at times by additional signal interference. We have received an average of around ten calls or emails per month from users. The most common connection challenge reported to the city has been when the user is able to see Seattle Wi-Fi on their list of available wireless networks, but are not able to connect. This is often because the laptop or other wi-fi device is not able to transmit a strong enough signal to connect with an access point, though the access point transmits a signal strong enough for the computer to see it. In short one speaker (the access point) has a megaphone (strong radio transmitter) and the other speaker (the user) has a weaker voice. Manufacturers recommend more access points; hopefully, consumer wireless software will also be improved to be both stronger and more discriminating about identified access points.

The issue of articulating coverage expectations with an imperfect coverage technology has been challenging. We have advised users to move closer to a window in a shop and generally nearer the access point, or to obtain an additional antenna or stronger wi-fi device. The system solution is more

access points and interior access points to overcome foliage, glass and building signal diffusion. Fortunately, store employees and other users have learned where coverage is best and now help others.

Interior bridges were also tested to enable extension of the business district service to interior spaces. This has successfully provided coverage at three test sites in Columbia City and a fourth in the UDistrict: Columbia branch library, Bookworm Exchange, Rainier Valley Cultural Center/Southeast Effective Development, and Shultzy's Restaurant. As a result of this test, a hardware and installation solution we began offering this to other businesses through our vendor. The vendor provides coverage testing to sites to ensure the repeater install is feasible. The city is requiring compatible access points in order to maintain system control and monitoring. To date, two additional repeater sites have been installed. Additional marketing of this option will be developed in a later phase.

We also responded to a number of calls where Apple/Macintosh laptop users with a version of the web browser Safari were not able to connect. We determined this to be a Safari software bug and were able to provide users with a workaround using another browser.

### **Bandwidth management and security**

High bandwidth draw has been an issue in a limited number of cases. High volume uploading from wireless gaming devices has surfaced as a recent problem. Unfortunately in some cases, this appears to cause the access points to lock-up. To date, there have been a small number of users (less than 25) screened out from the system after they drew down large amounts of capacity over an extended period of time or used devices that could lock-up the access points. The system does not currently have the capacity to limit bandwidth per user.

Additional issues include attempted hacking into the access points to bypass them, and fake access point creation (potentially to steal user data). We have increased monitoring to track this.

### **Adding a log-in and password would increase security.**

Currently no identification is required to use Seattle Wi-Fi. Requiring a log-in and password would provide some increased security, though there was a question whether the system would lose users as a result. When asked whether registration and login would affect their use, the majority of users in the online survey indicated it would not impact their use, though approximately one-third of current users indicated it would reduce their use somewhat. Fewer than 10% stated they would stop using Seattle Wi-Fi if registration was required.

### **System monitoring, user monitoring and statistical tracking**

Usage statistics are based on the MAC address of the user and number of sessions; session time is logged but does not fully reflect usage patterns since a user does not necessarily log-out. At nine months into the project, the contractor set up a separate server for monitoring and reporting on usage; this automated data compilation and reporting which previously were performed manually. The system is currently monitored by DoIT staff with an alert for system outages tied to a pager notification system for staff and the maintenance vendor. Data reporting for system interruptions is not automated, though some data has been compiled manually.

The city found some shortcomings in monitoring capabilities with some instances where users reported an inability to connect before the operations center staff observed access point outages.

### **Limitations on log-in and starting pages**

Seattle Wi-Fi Evaluation; [www.seattle.gov/wifi](http://www.seattle.gov/wifi)

The current system only allows direction to only one page combined for the downtown parks and city hall, limiting the capacity for discreet location information. The City has been responsible for content management for the Columbia City/Rainier Valley page, with no specific content other than system identifications and sponsor links. The current system design enables identification of hits to [www.seattle.gov](http://www.seattle.gov) coming from Seattle Wi-Fi, but not the capacity to count the number of times a sponsor link is selected from the starting page.

### **Technical support**

DoIT provided staffing for maintenance and replacement of the wi-fi system. A significant amount of time has been required to develop and maintain the system to date. In cases of outages, DoIT and then the contractor attempt to resolve the issue via the operations center or remotely. However, many instances have required use of a bucket truck to go to the access points to reset, power cycle or provide other maintenance. Since DoIT does not have a truck at its disposal, this often results in outages greater than a day and must be done within the traffic constraints. There is one back-up staff person qualified to perform system maintenance.

### **Customer support**

The system was not funded for significant customer support though DoIT has worked to be as responsive as possible. Initially the only planned customer support was a phone line for customers to leave messages, with DoIT staff returning calls. The Community Technology program staff added their email address and, with a UW intern, responds to most requests. Where necessary, the contractor has also assisted with this. Current plans are to expand the phone message lines to provide information about hotspot coverage and common issues.

## **XII. Costs**

The initial funding allocation for building the Seattle Wi-Fi project was \$120,000. These funds were provided through the Office of Economic Development (\$42,000) as part of the Southeast Action Plan and University District redevelopment. The remaining amount (\$78,000) was provided through the Department of Information Technology.

The actual cost of installing, troubleshooting and maintaining the system has been significantly higher due to technical challenges. This cost has been covered by DoIT. The 2006 operating costs are estimated to be \$160,000. The 2007 operating costs are estimated to be \$100,000 plus \$57,000 for some high priority upgrades in order to enhance security and management, further develop web content and expand coverage in Freeway Park.

The cost of power for the poles is very modest and is absorbed by DoIT at this time. There is a cost for pole attachment for wi-fi devices. The annual rate in 2006 was \$728 per pole. From internal discussion and external conversations with potential vendors, this rate appears to be based on a cellular distribution market model and could be a barrier to a citywide deployment.

Internet costs were \$790 per month for 5 Mbps service, with the UW paying the first \$600 for five years and the remainder borne by the city with partner contributions of \$1500/year towards the project

from Rainier Valley organizations, Homesight and Atlantic Street Center. The business districts have covered a portion of marketing costs.

Additional marketing, community relations, user assistance and evaluation costs have been covered by DoIT under the Community Technology Program.

### **Providing ongoing services**

The cost centers of ongoing services to continue the Seattle Wi-Fi project include:

- Technical system operations support
- Power costs
- Pole attachment fees
- Customer support (phone/email and staffing)
- Partner and community relations
- Hardware maintenance and replacement
- Upgrades, such as monitoring and security software and hardware
- Marketing
- Web content management
- Evaluation

## **XIII. Partnerships and Other Interests**

The Seattle Wi-Fi project began to develop a public and business sector partnership, and has attracted a great deal of interest from vendors, other potential business partners and investors. The pilot project has also resulted in increased interest from community organizations, low-income housing providers and residents who want to see the project expanded to cover other areas. There was also some expressed interest in seeing the city encourage a distributed open source community wi-fi system, such as that in Champaign-Urbana. Finally it should be noted that we also found that there is governmental wi-fi planning and initiatives being developed in areas which adjoin the city of Seattle (e.g. White Center) and overlap with city jurisdictions (Seattle Public Library, Seattle Public Schools, Metro transit, King County, Seattle Municipal Court).

## **XIV. Conclusions & Recommendations**

The Seattle Wi-Fi pilot project has taught the City and its partners a great deal about the opportunities and the technical requirements of providing public wi-fi. In sum, our key conclusions as a result are:

### **Economic & Community Benefits**

- The total return on investment from wi-fi is unclear and challenging to measure, but Seattle Wi-Fi clearly has some economic benefit for the business districts as well as users of the service.
- The economic change is likely greatest in areas that previously had the least amount of wi-fi infrastructure and were most economically distressed.

- There is high general support for wi-fi, though we do not know how much the public is willing to pay for it.
- Wi-Fi serves as a complement Internet connection for local businesses rather than as the primary service, at least when deployed at a small scale.
- Wi-Fi serves both transitory visitors as well as local residents.
- Wi-Fi enhances the quality of place and existing civic infrastructure.
- Users want local content and the high opportunity of utilizing splash and landing web pages has not yet been well developed.
- Digital inclusion efforts require addressing connectivity as well as literacy, end-user access to hardware, and support for local content development and management.
- Marketing must be an ongoing component of service delivery.

### **Technical**

- Wi-fi is a fast evolving, though imperfect technology, subject to interference and building penetration design issues.
- It is critical to provide sufficient infrastructure investment to ensure reliability, user assistance, security, and monitoring.
- Addressing customer expectations and quality of service for customer premises needs to be addressed in system implementation and marketing.

### **Municipal Strategies**

- Municipal wi-fi has two potentially complementary, but distinct investment tracks: 1) as an internal city applications infrastructure and 2) as an external public network. The focus of this project was as a public network and the city does not yet have a clarified strategy for these two investment tracks.
- The City of Seattle at this point has limited capacity to operate a large scale wi-fi service.
- The City does not yet have a strategic Wi-Fi plan to guide future development of this pilot project nor city wi-fi services. The result has been some development of independent initiatives within city government and lack of a cohesive identity for those logging in via City sponsored wi-fi pages.
- There is not yet a clear definition of long-term roles for the city and its business and community partners in providing public wi-fi services.
- City initiatives concerning city-wide wi-fi need to be managed in conjunction with its exploration of developing fiber to the premise project. The two systems may be complementary in terms of a wi-fi services overlay on a fiber backbone and may have an impact on customer base and service delivery across both systems.
- Wi-fi strategic planning is not an information technology project alone; development of this community and municipal service should be integrated with other city and community planning.
- The city has some opportunity to guide public benefits (localized online content, digital inclusion, delivery of municipal services) in the wi-fi sector.
- There is a potential opportunity for the city to develop a municipal presence in providing localized wi-fi content (the online wi-fi landing pages), both on a municipal system and elsewhere.

## **Recommendations for Seattle Wi-Fi:**

Based on the pilot project evaluation and conclusions, the following recommendations were made to the Mayor:

- Continue the pilot service in 2007/8 with some operational enhancements for security, monitoring and reliability.
- Work with the city web team and community partners to further develop the portal content.
- Develop a citywide wi-fi strategic plan. This would include conducting an all-department internal assessment to better define the city wi-fi application needs and desired community benefits and digital inclusion strategy.
- Take advantage of privately fully-financed expansion projects as they arise, but work to complete a city strategy prior to any decisions on citywide wi-fi deployment.
- Ensure the wi-fi strategy is integrated into the potential fiber initiative.

## Appendix 1: Evaluation Methodology

The largest portion of the evaluation consisted of an online survey of users, and targeted surveying of businesses in the two neighborhood business districts (Columbia City and University District). Since the goals and scale of the parks' deployments were smaller, more focus was given to the business district evaluation. Nine non-users were also surveyed in July, 2006 to look for any unrecognized perspectives or impacts. Key survey results are presented in this report; a more complete technical report of the surveys is available as a separate document.

Users were surveyed via an optional on-line survey for a period of two weeks in July of 2006. The completed response rate was 8.6%<sup>11</sup> A small number of users were interviewed in-person to ensure the online survey would capture user experiences properly and to provide an opportunity for more in depth learning that may not have been written by on-line survey takers. Completed user surveys totaled 214. We received the same number of surveys from each of the two business districts (92); one-fifth of respondents (30) were parks and city hall users.<sup>12</sup>

Thirty businesses in the two business districts were interviewed in person.<sup>13</sup> In Columbia City, surveys were also presented to some at their business association meeting. If available, owners were interviewed. Otherwise, managers and other employees were interviewed. There were not sufficient resources to survey every business in the service areas, so a sampling of businesses was selected, in consultation with the business association partners. These samples focused first on those businesses where customers were most likely to use wi-fi, especially the restaurants and cafés (60% of surveys). The remainder was other types of retail businesses and services in order to provide some perspective from those that: a) did not have a primary wi-fi customer base, b) might have a secondary impact from wi-fi use, and c) could potentially be using wi-fi for their own business operations.<sup>14</sup>

User statistics collected through the wi-fi system were compiled and evaluated. User data analysis focused on the period from January through August 2006. The system's ability to automatically collect and parse data prior to that was limited. In addition, there were corrective upgrades made to the system in the first six months of operations and it was determined that data starting in January would be more reflective of a normalized operational scenario. Due to the design of the system, data is not available for a specific park or the City Hall lobby. The four parks and the City Hall lobby are treated as one hotspot with combined data.

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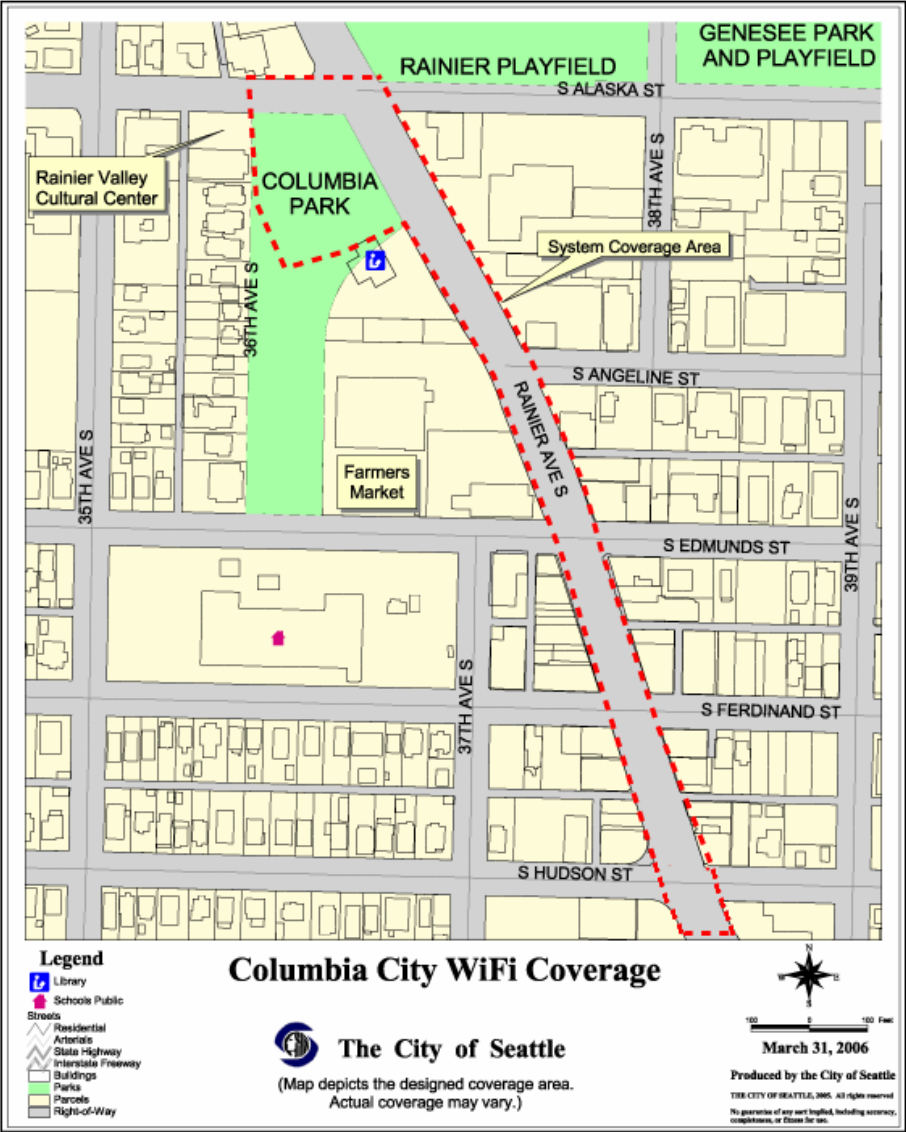
<sup>11</sup> All wi-fi system users, as defined by their MAC computer address, were offered the survey when they logged on. It was decided to make the survey optional to minimize interruptions to customer service. Once they completed the survey, the request to fill it out no longer appeared to that user. This self-selecting convenience sample method does create some risk that results are not indicative of the entire user population. However it also is more likely to result in more accurate answers since respondents are not trying to just get past the survey.

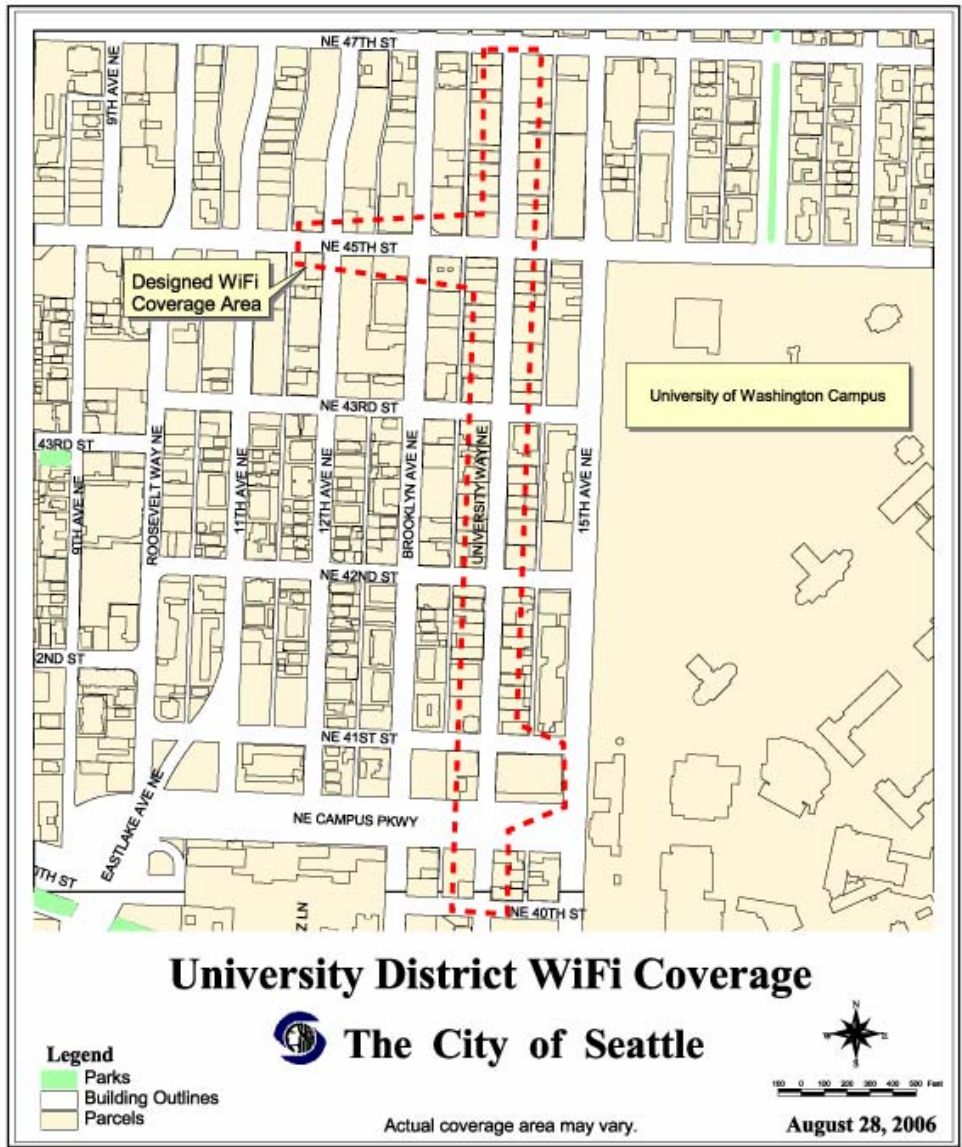
<sup>12</sup> The distribution of online survey respondents does not match the distribution of total logged-in users. Hence there is some under and over representation of locations. Following is each district with the total user percent followed by the percent of survey responses: U-District: 57%/43%, Parks/City Hall: 26/14, Columbia City: 17/43.

<sup>13</sup> A larger, somewhat more diverse sample was collected in Columbia City, providing 17 of the 30 responses. University District businesses were interviewed May 23 and 26, 2006. Columbia City businesses were interviewed July 5, 6, 11 and 12, 2006.

<sup>14</sup> 20% were retail and 20% were other types of service businesses (bank, library, fitness center, etc.)

# Appendix 2: Business District Coverage Maps





## Appendix 3: Entry or “splash” page

Portions of the entry pages for Seattle Wi-Fi system with terms of use. Sponsor logos are different for each locality.

seattle

WiFi hotspot


To use this service, you must read and agree to the terms below.  
Selecting "I agree" will establish your connection and launch our partners page.

**terms of use**


- Under no circumstances will the Provider be liable for any legal damages (whether based on tort, breach of contract or equitable theories) based on any claim of the user, or any of the user's heirs, assignees, appointees or successors-in-interest, and arising out of or as a result of the user's use of this wireless network.
- You agree to indemnify and hold harmless the Provider from any claim, lawsuit, liability, loss, damage, cost, expense or attorney's fees arising out of or relating to any actions initiated or caused by you while using this wireless network.
- If any provision of these terms and conditions is held to be unenforceable, such holding will not affect the validity of any of the other provisions of these terms and conditions.

Agree Decline

Brought to you by:

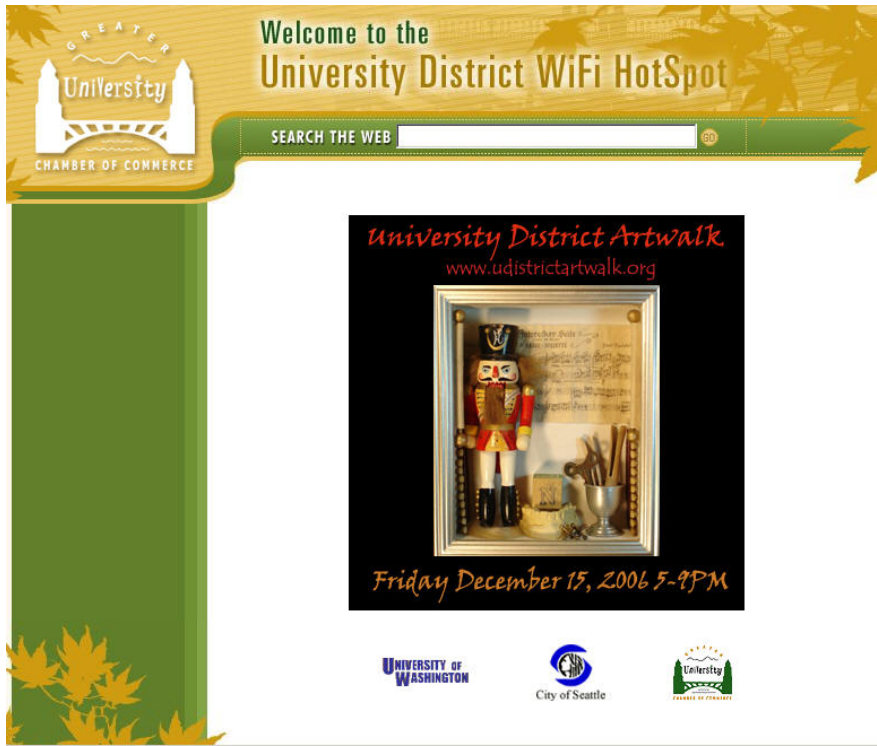


Columbia City  
Business Association



## Appendix 4: Landing pages

Samples of Seattle Wi-Fi landing pages for the two business districts which come up on the web browsers after users connect.





## Appendix 5: Street Signs and promotional cards



## Appendix 6: Glossary and Organizations Consulted

### Glossary of common terms and acronyms in this report

**802.11:** Refers to a family of specifications for wireless technology.

**Access point (AP):** Location of hardware that acts as a transmitter and receiver of wi-fi signals. Seattle Wi-Fi outdoor APs are typically located on light poles.

**Bridge:** Serves as an indoor relay for an outdoor wi-fi signal and acts as a smaller version of an access point.

**Hotspot:** The area surrounding an access point(s) in which a wi-fi signal can be used.

**MAC:** “Media Access Control”. Unique identifier nodes on a network. Each computer or portable device has its own MAC address.

**Login session:** A length of time that a computer is logged on to a wi-fi access point. This may be managed to terminate the user connection after the time length has been reached.

**Splash page:** The first webpage seen by wi-fi users. This is usually the log-in or sign-in page,, though it sometimes refers to the first page seen after connecting.

**SSID (Service Set Identifier):** The name of a wireless local area network. Open networks such as Seattle Wi-Fi broadcast the SSID to all devices with wireless capabilities. The SSID for Seattle Wi-Fi is *seattlewifi*.

**Wi-fi:** An abbreviation for "Wireless Fidelity". A technology that provides mobile devices like Laptops, PDAs, and Smart Phones untethered access to the Internet via a wireless network

### Organizations Consulted for this Evaluation

ACJ Technology Solutions (Wi-fi consultant contracted with DoIT)

Atlantic Street Center

Columbia City Business Association

Citizens’ Telecommunications and Technology Advisory Board (CTTAB)

Department of Neighborhoods

Department of Parks and Recreation

Homesight

King County Department of Transportation

Office of Economic Development-City of Seattle

Office of the Mayor, City of Seattle

Seattle City Council

Rainier Valley Chamber of Commerce

Seattle City Light

University District Chamber of Commerce

University of Washington

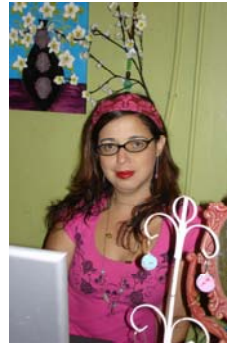
The primary City of Seattle Department of Information Technology team working on the Seattle Wi-Fi project have included David Keyes, Stan Wu, Andy Stankovics, Doug King, UW Evans School of Public Affairs intern Ken LeBlond, Dean Arnold, and Chief Technology Officer Bill Schrier.

## Appendix 7: Seattle Wi-Fi User Profiles and Comments



**Tiffany Larsen** uses Seattle Wi-Fi not only for her personal use but also for her graphics design business, uberpop.com. As a resident of the Columbia City neighborhood, she takes a short walk to the business district to do work for her clients. Actually, several of

her clients include local businesses. Not only does Seattle Wi-Fi benefit her but she sees many people on their laptops. *“It’s really helping the businesses and it’s definitely an asset”*. She has also noticed an improvement in the signal since fiber optic cable was installed in May of 2006.



As the owner of small retail business in Columbia City, **Karla Esquivel** appreciates Seattle Wi-Fi. If a customer at Andaluz has a request that can be best handled through the Internet, Karla connects to Seattle Wi-Fi from her store counter. This saves time for both her and the customer and her access enhances the

customer’s experience while at the store. Free access also saves Karla money that she would have spent towards commercial Internet service or fax services. *“It’s awesome. I’m glad I have it.”*



In March of 2006, the city installed a wi-fi “bridge” inside the front door of Shultzzy’s Restaurant on the University District’s “Ave”. The bridge

relays the Seattle Wi-Fi signal from the outside and spreads it indoors. *“We get it throughout our business”*, says Manager **Tim Tinker**. *“We often use it to make on-line orders, post help wanted ads and check job applications”*. Additionally, a web management company used the Seattle Wi-Fi signal to design the restaurant’s website while enjoying the restaurant’s food and beverages!



**George Curtis** lives in Columbia City and has been using Seattle Wi-Fi for the last several months. With the help of an antenna he is able to

use Seattle Wi-Fi on his desktop computer. *“It’s been an asset. I cancelled my [dial-up] ISP so Seattle Wi-Fi is now my only means of Internet access”*. George also recognizes another benefit to the free access, *“It’s probably helping low-income people to afford it”*.

**Demetre Lagos** owns and operates the **Continental Pastry Shop and Greek Restaurant**, on the “Ave” in the University District. He is appreciative of the city’s initiative with technology via Seattle Wi-Fi. *“I commend the city for staying on the cutting edge”*, he says. He also sees the benefit to his patrons. The presence of Seattle Wi-Fi *“enhances the customer experience and increases the appreciation for the business”*. (No photo)

## Seattle Wi-Fi User Comments

- *“It distinguishes you as a city and it's especially nice because people come to Seattle expecting high tech, and lo and behold, you actually provide it.”* - University District user
- *“I can go into my favorite places, even though they don't supply wi-fi!”* - University District user
- *“Great job in improving connectability--I've noticed a huge improvement in the last month or so.”* - University District user
- *“It makes casual business meetings possible in local restaurants. If there weren't wi-fi available, I would not use the local businesses as much during the daytime.”* - Columbia City user
- *“Because there is wireless in Columbia City, I opt not to work at home and head to a local coffee shop to work or check email. I've done this many times now and will continue.”* - Columbia City user
- *“I often choose to go to businesses in Columbia City over other areas because of the access to free Wi-Fi.”* - Columbia City user
- *“This is a great and forward-looking service, making internet access accessible to more people. It is the kind of government-supported program that makes life better and does so more immediately. I hope it continues, otherwise I won't be able to afford it at my small business. Thank you very, very much.”* - Columbia City user
- *“Because I office remotely, I spend much of my day in cafes and public spaces that offer internet access. If it were not for this publicly provided WI-FI, I would not have frequented Cafe Umbria. I spend an average of \$20 a day there.”* - Occidental Park hotspot user
- *“Thank you Seattle! You are very friendly to techie visitors! ☺”* - Parks user