U.S. Department
of Transportation

FTA
Federal Transit
Administration

FINAL REPORT

REPORT DOCUMENTATION PAGE		*Form Approved OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE May 31,2005	3. REPORT TYPE AND DATES COVERED March 2004 to May 2005
4. TITLE AND SUBTITLE Washington State Ferries (WSF) Wireless Connection Project (WCP) Evaluation		5. FUNDING NUMBERS WA-26-7006
6. AUTHOR(S) A. J. Grant, M. J. Holden, B. Ludlow, T. M. Thiele		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Mobilisa, Inc. 191 Otto Street Port Townsend, WA 98368		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Federal Transit Administration U.S. Department of Transportation Washington, DC 20590 Website URL [www.fta.dot.gov]		10. SPONSORING/MONITORING AGENCY REPORT NUMBER FTA-WA-26-7006-05.2

11. Supplementary Notes. Companion report is Washington State Ferries Evaluation Results, reference number FTA-WA-267006-05.1

12a. DISTRIBUTION/AVAILABILITY STATEMENT **Available From:** National Technical Information Service/NTIS, 5285 Port Royal Road, Springfield, Virginia 22161. Phone 703.605.6000, Fax 703.605.6900, Email [orders@ntis.fedworld.gov]	12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words) The purpose of the Washington State Ferries (WSF) Wireless Connection Project (WCP) was "to provide passengers of the WSF system continuous high speed internet access at the dock and onboard ferries while en route to enhance the user experience. The objective of this report is to document the evaluations of the project and results of corrective actions and determine if the design, installation, and execution of WSF WCP succeeded in its purpose. The mobile wireless network was designed, installed, tested, and operated by Mobilisa, Inc. over the course of a 15 month period. Independent wireless network performance evaluations were conducted by Lockheed Martin Information Technology over several months to provide non-biased assessment and constructive criticism of the system. The results of these evaluations and corrective actions are included in this report's appendices, as is a sample survey and business case analysis.

14. SUBJECT TERMS Evaluation of Washington State Ferries Wireless Connection Project, High Speed Internet Access, Wireless Over Water, Wireless Internet access aboard ferries, Wireless, Ferries, WSF, WCP, Mass transit Internet access	15. NUMBER OF PAGES 45
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. 239-18298-102

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Washington State Ferries
Wireless Connection Project

FINAL REPORT

FTA Report Number: FTA-WA-26-7006-05.2

August 29, 2005

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FOREWORD

"I am very pleased with the success of this project, and I don't say that often. I would classify this project as a complete success."

-Jim Long, IT Director, *Washington State Ferries*

This document is being published to inform the public about the Washington State Ferries (WSF) Wireless Connection Project (WCP).

The purpose of the WSF WCP was to explore the feasibility of providing passengers on the WSF system continuous high speed internet access while at the dock and onboard the ferries as a potential enhancement to the passenger experience.

The mobile wireless network for the WCP was designed, implemented, tested, and maintained by Mobilisa, Inc. over the course of the project.

Independent wireless network performance evaluations were conducted by Lockheed Martin Information Technology to provide non-biased assessment of the system. A sample survey and business case evaluation were also performed to validate the Business Case Study submitted by Mobilisa, Inc.

The results are summarized in Appendix C of this report.

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This report is directed to the Washington State Ferries and Federal Transit Administration.

EXECUTIVE SUMMARY

The Washington State Ferries (WSF) Wireless Connection Project (hereinafter referred to as the WSF WCP) is a feasibility study for establishing a seamless wireless network to provide Internet connectivity for passengers using three major ferry routes which cross the Central Puget Sound.

Fig 1 - Wireless passenger on Seattle Bainbridge route

Often commuters onboard the ferries find that their commute time is underutilized.

Many desire to make the most of their commute by using the wait and crossing time to access work remotely, read the news, catch up on personal email, or just surf the Web.

Working closely with the WSF and funded by a Department of Transportation grant, Mobilisa, Inc designed and installed a wireless network to provide Internet access to the parking/waiting areas, ferry terminals, and most importantly, the ferries themselves, while they transit between terminals.

The WSF WCP essentially treats approximately 400 square miles of the Puget Sound as one big Wireless Area Network, with Wi-Fi service to the Internet available to riders aboard the Washington State Ferries.

The technology has proven to be very successful, and the demand from the customers is consistently positive.

It is recommended that the WSF WCP be expanded to include all of Washington State Ferry routes and terminals.

" I was in a hurry and needed to catch a ferry and didn't have time to send my business report, was very happy my computer notified me I was in range of an excellent signal and it only took the amount of time to answer the questionnaire. Thank you – it worked great!!"
- Ferry User

BACKGROUND

The Washington State Ferries (WSF) is the largest ferry system in the United States, with 28 million rider events every year. WSF operates 29 vessels and 20 ferry terminals throughout the Puget Sound.

Ferries in Washington State are a way of life for people in the area; every weekday morning more than 75,000 Puget Sound residents commute to work or school aboard Washington State Ferries.

As with any daily commute traffic can sometimes backup and cause a delay. Ferry wait times can often be long on busy travel dates. Transit time is typically between thiry and sixty minutes.

Many passengers want to make the most of this time to log on to their laptops, PDAs and 802.11 enabled phones. Whether it is simply reading the news, sending an email, or actually working, commuters would like the option to have access to the Internet.

Recognizing a need to enhance the customer experience, Washington State Ferries wanted to offer wireless Internet service to its riders. Increasingly, much the same way mobile phones have gained in popularity, consumers expect their PDAs and laptops to allow them access to the internet, regardless of where they are, their method of transportation, or the speed at which they are traveling.

The WSF WCP was awarded to Mobilisa Inc. to research and develop ways to provide passengers with continuous high-speed Internet access at the dock and onboard the ferries while en route.

The two main objectives of this project were to improve the WSF rider experience and to maintain a persistent Internet connection throughout their travels.

Fig 2 - WSF ferry routes

PROJECT

The project was organized into six tasks; Requirements, Business Case Study, Design; Installation, Support and Third Party Evaluation.

1. Requirements

Shore-based wireless radios, operating at unlicensed frequencies and transmitting powers, needed to carry the Internet signal to the parking/waiting area, the ferry terminal, and to the ferry while it transits between terminals. This Internet access served two specific functions: Ship Services and Passenger Services.
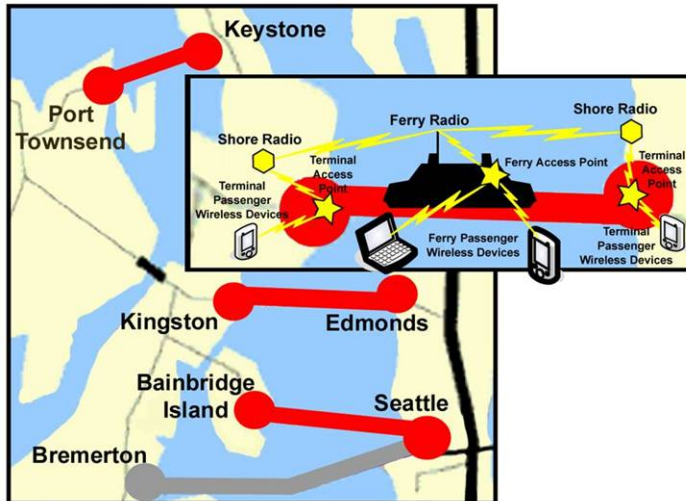

Fig 3- Basic project diagram

Ship Services included internet connectivity for the crew while Passenger Services focused on passenger Internet access through personal wirelessly enabled devices.

Users of both services needed the ability to access the Internet via commercial off-the-shelf (COTS) wireless devices.

These devices include laptop computers, Personal Digital Assistants (PDA), or cell phones. Many of these devices are wirelessly enabled at the factory, or can be wirelessly enabled for very little cost.

A detailed report entitled "Systems Requirement Document" was delivered to the WSF in January of 2004. This 20 page report listed specific and detailed requirements of the WSF WSP.

2. Business Case

A Business Case Study submitted by Mobilisa outlined the business case options for implementing wireless Internet services for WSF customers. It was reviewed by Dr Chad Higgins, Professor of Business at the University of Washington.

"This Wi-Fi internet service on the ferry is better than my cable internet service at home! I will happily pay for this service."

- Ferry User

It addressed the types of use, equipment used, types of rider-ship, and results of the online survey. It analyzed the information gathered through the survey. Based upon this information and other research, the Business Case Study presented information on demographics, other wireless uses, pricing strategies, cost-benefit analysis, end user licensing agreements, and customer privacy.

Fig 4 - Wireless laptop passenger on Port Townsend Keystone route

Based on the passenger survey and research performed by Mobilisa Inc we conclude that providing a wireless Internet system aboard the WSF is feasible and desired by the WSF passengers.

The Business Case Study in its entirely was delivered to the WSF in March of 2004. A copy is attached to this report as Appendix B.

3. Design

"We took wireless technology and pushed it to the extreme, proving that Wi-Fi can operate in a mobile and marine environment.
- Dr. Nelson Ludlow, CEO, MOBILISA, INC

A vessel containing a network and moving through separate and distinct shore-based networks provided an engineering challenge. The system required switching between antennas while maintaining connectivity for the users. Continuous connectivity and sustained Internet sessions were key focal points of this research.

The WSF WCP network could not interfere with other electronic systems aboard the ferries. Engine room wireless systems, GPS, and other navigation systems, along with all electronics must be free from RF interference.

Shore antennas needed to be weatherproofed and capable of withstanding winds of 100mph.

All equipment on the vessels is uniform so when they are moved between routes the network can operate without any adjustments to the system. The vessel antennas are waterproof and able to withstand the wind forces encountered on the ferry.

There is a web-based system in place for users to sign up for network service and to manage their accounts. Clients may use 802.11B enabled wireless devices, such as laptop computers, PDAs, or cell phones, to access the wireless Internet service. Many of these devices come from the factory wirelessly enabled, while those not wirelessly enabled can use an inexpensive wireless PC card.
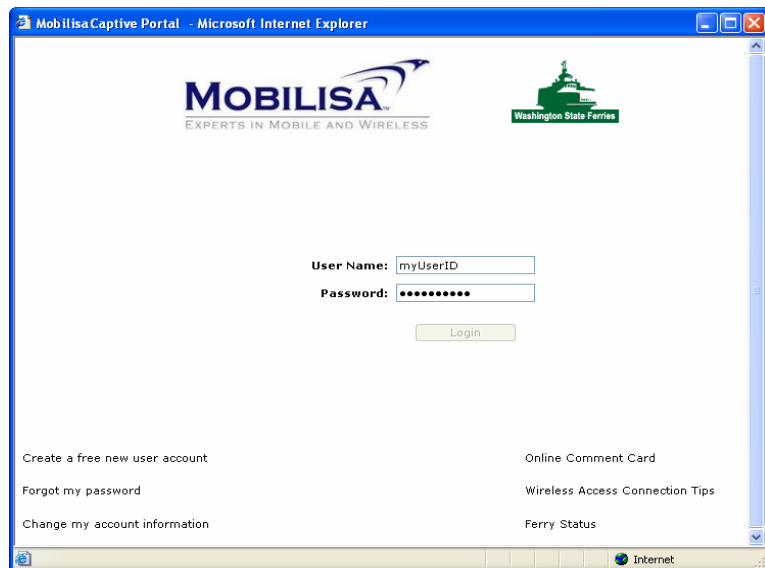

Fig 5 - WSF WCP login screen

4. Installation

Mobilisa engineers surveyed the various shore sites for access point and backhaul equipment locations.

Permits were acquired, when necessary, for antenna placement for shore sites when placement on the terminals was not an option.

Fig 6 – Antenna installation on terminal

Working closely with the WSF, engineers installed shore site and terminal antennas; antennas, access points and NEMA boxes on the vessels and access points in the terminals.

Installation of equipment onboard the vessels could only take place while the ferry was in for scheduled maintenance. Daily coordination with various members of the WSF facilitated the timely manner in the ability to accomplish this task.

Monthly status reports outlining the installation process have been sent to the WSF since August of 2003.

The WSF WCP is the largest implementation to date of an IEEE 802.11 network on a passenger ferry system.

The project successfully installed a mobile Wi-Fi compliant network over water at six ferry terminals and on five ferry vessels as part of three major WSF routes.
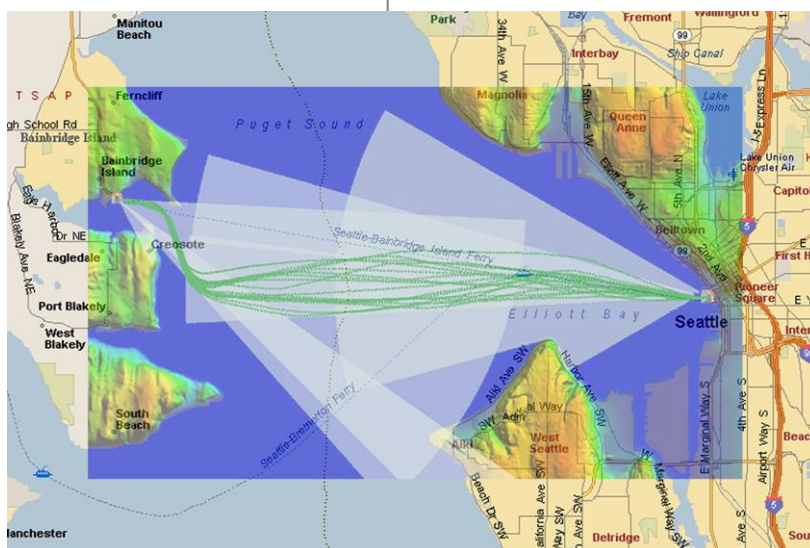

Fig 7 – "Ping Plot" coverage map of Seattle Bainbridge route

WSF customers seamlessly roam with Wi-Fi equipped devices within all major areas of these three routes.

The selected routes were the Seattle to Bainbridge Island, the Edmonds to Kingston and the Port Townsend to Keystone ferry routes.

"Having this service on my commute assists me in being able to go to school online while I commute from work and home. This has made me much more productive."
- Ferry User

The ferry vessels that were equipped with the system were the M/V Klickitat, the M/V Puyallup, the M/V Spokane, the M/V Tacoma and the M/V Wenatchee.

The system utilized four independent Internet Service Providers (ISP) for wired service and spanned four counties.

5. Third Party Evaluation

Lockheed Martin Information Technology performed a third party evaluation of the WSF WCP. A summary of that evaluation is attached to this report as Appendix C.

6. Support

Mobilisa continues to monitor and support the WSF WCP.

A special software program has been created to map the connectivity of each vessel on every route covered. The results of this program are graphically represented in a "Ping Plot" map. If, for any reason, there is a loss of signal, our engineers investigate as to why.
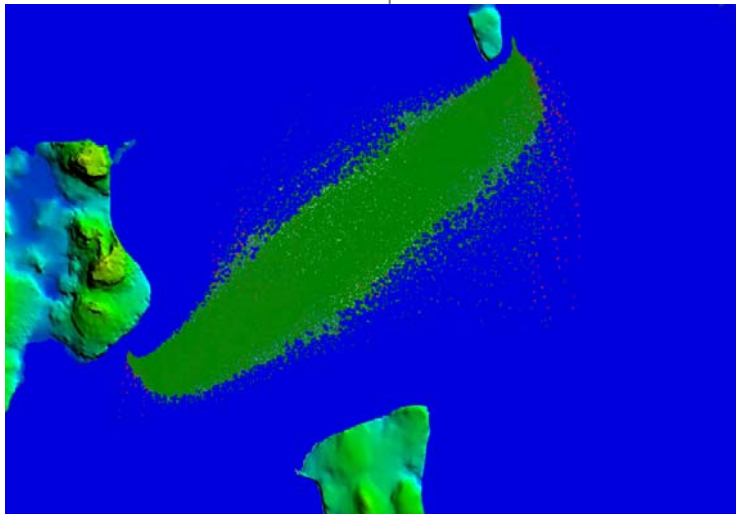
Fig 8 – "Ping Plot" coverage map of Port Townsend Keystone route

Informative brochures and posters were made available onboard the ferries to aid passengers in logging onto the WSF WCP.

Mobilisa also established a help desk with a special toll free number – 1-800-WSF-WiFi. Passengers who experience difficulty can call 8am to 5pm weekdays for an immediate answer to their questions.

The WSF WCP brings high-speed wireless internet access to customers, crew and vendors onboard the Washington State Ferries.

DISCUSSION

"I have been extremely delighted with your service since its inception. Please accept my thanks for the great service you are providing"
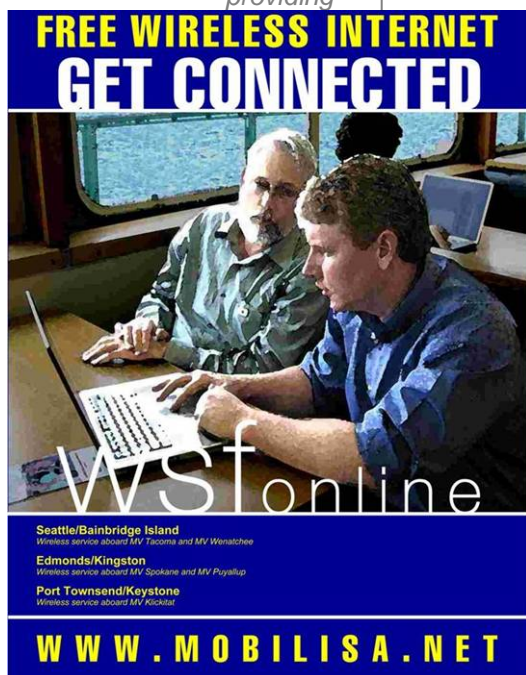

Fig 9 – "Get Connected" WSF WCP poster

- Ferry User

The goal of this project was to develop a solution for maintaining a constant wireless internet connection aboard the Washington State Ferries. This system is designed to allow for deviations in the regular routes due to tides, ship rotation, weather, and boat traffic.

Utilizing their Wireless Over Water (WOW™) technology, in conjunction with advanced switching algorithms, Mobilisa created a network that broadcasts wireless internet across the entire ferry route, encompassing the major targeted Puget Sound ferry runs.

The WSF Wireless Connection Project is the first such system of its kind in the world. Previously, wireless was thought to travel only a few hundred feet at best.

By developing this system, Mobilisa has successfully proven that Wi-Fi can not only travel over many miles, but it can do so while *in-motion*. So, just as drivers expect mobile phones to work while they are moving, customers onboard the ferries can expect the same level of seamless roaming with wireless internet.

The ultimate goal of the system was to improve the *overall* rider-ship experience onboard the Washington State Ferries.

Utilizing this technology, passengers can now access the internet, send email, surf the web and even download music.

Fig 10 – Wireless passenger to Seattle surfs and sips

"This service is a wonderful asset to have at a ferry terminal or onboard a vessel! With wait and travel times often being significant within the ferry system, being able to make productive on-line use of my time is invaluable. I couldn't find enough positive things to say about this! Please continue with (and hopefully even expand to other ferries) this excellent service!"
- Ferry User

This project had the "usual" WLAN design challenges, as well as several situations unique to the Washington State Ferries.

The easiest requirement was scalability. Like any large organization, Washington State Ferries needed to know that the system could handle 300 – 400 concurrent users in a timely manner.

One of the basic promises of wireless access is to further productivity – therefore the speed of the system is invaluable for driving usage.

The other challenges were quite unusual. For example, the wireless network needed to incorporate the moving ships as well as passengers moving through the ferry system.

Making wireless work *in-motion* involves an advanced network that requires complex switching algorithms to allow passengers to stay connected. Since the boats move between shore sites, the WLAN had to provide seamless and fast handoffs between access points and the central routers.

This ability to maintain an "always-on" connection while the consumer is "roaming" among access points is vital to any high-speed transportation application. Mobilisa's WOW™ technology has far surpassed these design requirements.

One of the measurements that the project incorporated is the satisfaction of the customer. Of the Washington State Ferry passenger survey respondents, 88% indicated that they would use wireless internet service onboard the Washington State Ferries, if it were available.

Fig 11 – Wireless passengers share a happy moment

Now that the service is available, the contractor and the Washington State Ferries have been receiving positive feedback from consumers.

Users of the system are pleased with the availability, speed of service, and ease of use. In this instance, the feedback has shown that Mobilisa and Washington State Ferries met their goal of improving the rider-ship experience.

CONCLUSION AND RECOMMENDATIONS

"Thank you SO much! This is a wonderful service, please continue this! You have made my professional life SO much better!"
-   Ferry User

What started out as a "Proof-of-Concept" project has far exceeded initial expectations and has developed into a fully functioning mobile and wireless high-speed Internet system that functions in a marine environment**.**

Washington State Ferries customers are very pleased with the system.

Independent evaluators are impressed with the technical hurdles this project had to overcome to provide near continuous wireless Internet access onboard a moving vessel across the Puget Sound. A very large portion of the passengers using the system feel that the wireless service is acceptable or better, and are willing to pay for the service provided.

It is recommended that the system be expanded to include all of Washington State Ferry routes and terminals, with particular emphasis on the other daily commuter routes. The technology has proven to be successful and the demand from the customers is very promising.

For other ferry systems where improving the rider-ship experience with high-speed internet access is desired, or increasing security and productivity of crew members is crucial, or where cell phone coverage along the ferry routes is marginal or non-existent, a system like the Washington State Ferries Wireless Connection Project should strongly be considered.

Acknowledgements

Mobilisa would like to acknowledge the assistance of FTA project sponsor, Charlene Wilder, Kenneth Feldman FTA Region 10, and the WSF Program Sponsor, James Long, provided overall direction of the work.

APPENDICES

Appendix A Abbreviations and Terms

Appendix B Mobilisa Business Case Study

Appendix C Third-Party Evaluation Synopsis

ABBREVIATIONS AND TERMS

Access Point   (AP) a hardware device that acts as a communication bridge for users of a wireless device to connect to a wired Local Area Network.

Backhaul   In wireless network technology, to transmit voice and data traffic from a remote site to the network backbone.

COTS   Commercial Off-The-Shelf

DOT   Department of Transportation

FTA   Federal Transit Administration

Hotspot   A specific geographic location in which an access point provides public wireless broadband network services to mobile visitors through a WLAN.

IEEE 802.11   The Institute of Electrical and Electronics Engineers specification for Wireless Local Area Networks. which specifies an over-the-air interface between a wireless client and an access point or between two wireless clients.

ISP   Internet Service Providers

IT   Information Technology

Internet   A global network connecting millions of computers. More than 100 countries are linked into exchanges of data, news and opinions

LAN   Local Area Network.

Mobilisa   Mobilisa, Inc.

M/V   Marine Vessel

PDA   Personal Digital Assistant

RF   Radio Frequency

WAN   Wide Area Network

WLAN   Wireless Local Area Network

WCP   Wireless Connection Project

WiFi   Wireless Fidelity or commonly used when referring to the IEE 802.11a, IEEE 802.11b or IEEE 802.11g specification.

WSF   Washington State Ferries

World-Wide-Web   "WWW" or "The Web"- A system of Internet servers that support specially formatted documents as well as graphics, audio, and video files.

WoW   Wireless over Water – a technology specific to Mobilisa which allows the broadcast of an 802.11 signal over miles of water

Washington State Ferries Wireless Connection Project

Business Case Study

Prepared By:

Mobilisa, Inc.

2023 E Sims Way #346

Port Townsend WA 98368

Contract #:	DP00746
Nomenclature:	Washington State Ferries Wireless Connection Project
Title:	Business Case Study
Task Order #:	0001
CDRL#:	A003
Classification:	Unclassified
Date Prepared:	01 March 2004
Prepared By:	Ms. Claudia Monroe
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Issuing Authority:	Washington State Department of Transportation (WSDOT)

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Summary

The Washington State Ferries (WSF) Wireless Connection Project (WCP) is a project that will study the feasibility of the WSF using an 802.11 Wi-Fi data network aboard the ferries to develop a Floating Area Network (FAN). The goal of this project is to provide continuous connectivity to passengers and to enhance the ridership experience.

This is a project of particular importance to the WSF because it will help them fulfill their vision of being the most efficient and affordable, customer focused ferry operator in the world. This project will be implemented with the principal goal of improving rider experience. This will help WSF advance the objective of customer satisfaction, their primary goal.

In addition to customer service, wireless Internet service on the WSF will also help fulfill major goals including continuing to improve and refine business processes, broadening revenue base, and re-defining the service provided. This project will assist in meeting all three goals in that it will refine business processes with the added use of debit/credit cards, broaden revenue base with the added royalties paid to the WSF for wireless Internet access by ferry riders, and it will re-define them as innovators in their field.

This Business Case Study reviews the business case options for implementing wireless Internet services for WSF customers. It addresses the types of use, equipment used, types of ridership, and results of the online survey. It analyzes the information gathered through the survey. Based upon this information and other research, the Business Case Study presents information on demographics, other wireless uses, pricing strategies, cost-benefit analysis, end user licensing agreements, and customer privacy.

Based on the passenger survey and research performed by Mobilisa Inc we conclude that providing a wireless Internet system aboard the WSF is feasible and desired by the WSF passengers. The preferred method of providing this service is to allow passengers to connect to multiple Internet Service Providers (ISPs) that have agreed to offer service aboard the ferries. These ISPs would then pay royalties to the WSF for the added customer usage. The maintenance of the wireless Internet network would be performed by a 3rd party contractor to the WSF. This would provide the most choices for the customers and the most simplicity for the WSF.

INTRODUCTION

The Washington State Ferries (WSF) Wireless Connection Project (WCP) is a project that will study the feasibility of the WSF using an 802.11 wireless data network aboard the ferries to develop a Floating Area Network (FAN). The main goal of this project is to offer continuous wireless Internet connectivity to passengers in order to improve the rider experience.

This is a project of particular importance to the WSF because it will help them fulfill their vision of being the most efficient, and affordable, customer focused ferry operator in the world. This project will be implemented with the principal goal of improving rider experience. This will help WSF advance the objective of customer satisfaction, their primary goal.

This Business Case Study reviews the business case options for supplying wireless services for WSF customers. It addresses the types of use, equipment used, types of ridership, and results of the online survey. It analyzes the information gathered through the survey. Based upon this information and other research, the business case study presents information on demographics, other wireless uses, pricing strategies, cost-benefit analysis, end user licensing agreements, and customer privacy.

TYPES OF USE

This new wireless system can be used in many different ways. Both passengers and vendors on the WSF will be able to utilize this system. It can be used for business, entertainment, money transactions, or for security purposes. The customers can utilize the system with several different devices, such as laptops, PDAs and cell phones, to perform multiple tasks. Because of the growing popularity of wireless technology, the cost of wireless components is dropping quickly. As a result, the number of wireless networks in homes, offices, and public places is increasing at a tremendous rate. In turn, this has caused the wireless enabled devices market to grow rapidly.

LAPTOPS

Laptop computers are portable versions of desktop computers. They are generally much more compact and lightweight than a desktop computer. Most laptops provide the same functionality as a desktop, but allow the user to take the computer anywhere, within reason. Power is provided by internal batteries and external power cords.

Of the 36 million business travelers in the United States, 27 million carry laptop computers. 35% of all notebooks shipped out in 2003 were shipped with built-in Wi-Fi radios. It is expected that this number will grow to 90% by 2005. Users with built-in Wi-Fi radios need no additional equipment to connect to the wireless network. They need only to set up an account and they will be able to wirelessly access the Internet.

Most laptop users whose computers do not contain Wi-Fi radios can purchase a wireless Internet card to make their laptops wirelessly enabled. This external card is inserted in to the "credit card" slot on their laptop. This will allow them to use the WSF wireless service to access the Internet or corporate networks.

Figure 1 - Laptop

PDAS

Personal Digital Assistants (PDAs) are computers that are small enough to be carried and operated in the user's hand. These devices are portable and run on batteries that are rechargeable via external power. Most have touch screen capabilities and may receive user input from a pen-like device, or "stylus" on their touch

screens. Many have portable and/or built in alphabetic, numeric, and custom keyboards that are displayed on the screen.

PDAs allow the user to keep track of appointments, e-mail messages, files, etc. in a compact device. Many are able to connect to a wireless network via internal or external wireless cards. PDAs can be synchronized with the user's desktop or laptop computer to consolidate files and information via cables or various wireless technologies. The usage by consumers and the availability of PDAs is steadily increasing.

Figure 2 - PDA

CELL PHONES

Pocket PC Phones

A Pocket PC Phone is roughly the same size as the PDA, but comes with built-in wireless connectivity through a commercial wireless carrier. Pocket PC Phone devices include all standard Pocket PC features. These features may include Pocket Word, Pocket Excel, Calendar, Notepad, Contacts, Calculator and games. They allow users to access the Internet and corporate networks, as well as send and receive e-mail, with the added benefit of being able to send and receive calls.

Figure 3 - Pocket PC Phone

Smartphones

The Smartphone integrates limited PDA type functionality into a voice-centric handset. The Smartphone has the ability to provide wireless access to Microsoft Outlook information and allows users to browse corporate and Internet information and services.

Smartphone

Figure 4 - Smartphone

FUTURE WIRELESS ENABLED DEVICES

Many other devices will be able to utilized Wi-Fi in the near future.   New vehicles are already manufactured with devices that could make use of wireless technology. The owner could use it during travel to get the latest traffic and news updates. This would enable the consumer to use their time more efficiently while traveling and could be an especially interesting option for the WSF to consider in the future.

Gaming devices and consumer electronic devices will be implementing wireless abilities when cheap low-power Wi-Fi chips are available. Gaming devices will allow players to connect to public or private networks to participate in multi-player games.

Once these less expensive Wi-Fi chips hit the markets they could be utilized by many different kinds of consumer electronic devices, like MP3 players or digital cameras. MP3 users could download music from any location and digital cameras could be used to upload pictures right after they are taken.

Figure 5 - Devices

RIDER EXPERIENCE

One of the primary goals of the Washington State Ferries is to improve its riders' experience. With this project the riders will be able to access the wireless Internet while aboard the ferry and enjoy continuous connectivity throughout their trip. This will enable riders to use their time spent aboard, and waiting for the WSF, more efficiently.

TYPES OF RIDERSHIP

The Washington State Ferries cater to many different types of riders. Their ridership has grown to over 26 million passenger rider events per year. As an extension of the Washington State Highways it is a widely utilized travel option for commuters, employers, students, commercial shippers, and vacationing tourists.

Riders of the Washington State Ferries fall into three categories: vehicles and their drivers, passengers in vehicles, and walk-on passengers. The ferry ridership numbers vary greatly dependant upon season, day of week, and time of day. The majority of WSF ridership is concentrated on three routes: Seattle/Bainbridge Island, Edmonds/Kingston, and Mukilteo/Clinton.

CURRENT RIDER EXPERIENCE OPTIONS

Washington State Ferry riders may board the vessel as a vehicle driver, as a vehicle passenger, or as a walk-on passenger. All passengers are able to utilize the amenities offered by the ferry system. The onboard services currently available include sun deck, video games, vending machines, ATM (on some vessels), lounge chairs, booths with and without tables, newspapers, and area attraction brochures. Food service was discontinued in January 2004 but is expected to resume by late-2004.

PROJECTED RIDER EXPERIENCE OPTIONS

In addition to the currently offered services, riders will be offered the option of purchasing Internet access through a wireless service. For the price of their subscription they will be able to access the Internet from any wireless enabled device, such as laptops, PDAs, cell phones, or WSF provided Internet kiosks. They could use this service to work, browse the web, chat, email, read the news, or download music. The possibilities are endless. We do not initially recommend kiosks because of the high maintenance costs and potential for vandalism.

TEST ROUTES

Port Townsend/Keystone

The Port Townsend/Keystone Ferry route is approximately 4.3 nautical miles and takes an estimated 30 minutes per crossing. It currently employs two vessels, the M/V Quinault and the M/V Klickatat, and carries an estimated 840,000 passengers per year. This will be the test run for the WSF WCP project.

Mobilisa will install two separate networks, using different technologies, aboard this run to determine the best system to be implemented on the other routes.

Figure 6 - Port Townsend/Keystone Ferry
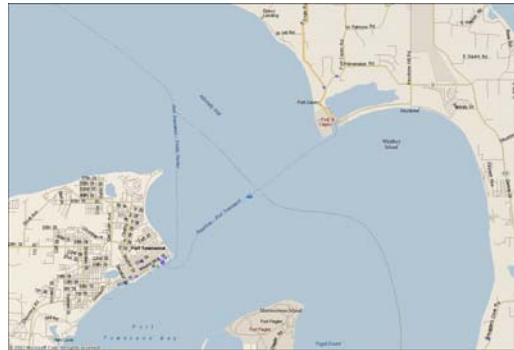
Bremerton/Seattle

The Bremerton/Seattle Ferry route is approximately 13.5 nautical miles and takes an estimated 60 minutes per crossing. It currently employs two vessels, the M/V Hyak and the M/V Kitsap, and carries an estimated 2,405,000 passengers per year. This is the longest and most complicated run to be included in the first installation.

Figure 7-Bremerton/Seattle Ferry

Kingston/Edmonds

The Kingston/Edmonds Ferry route is approximately 4.5 nautical miles and takes an estimated 30 minutes per crossing. It currently employs two vessels, the M/V Puyallup and the M/V Spokane, and carries an estimated 4,758,000 passengers per year. The Kingston/Edmonds run carries many commuters to work every day.
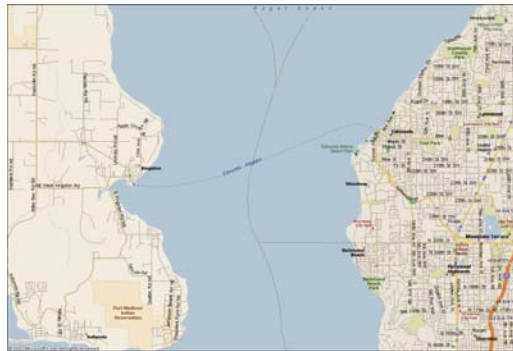
Figure 8- Kingston/Edmonds Ferry

1.1.1   Bainbridge Island/Seattle

The Bainbridge Island/Seattle Ferry route is approximately 7.5 nautical miles and takes an estimated 35 minutes per crossing. It currently employs two vessels, the M/V Tacoma and the M/V Wenatchee, and carries an estimated 7,140,000 passengers per year. The Bainbridge Island/Seattle run is, by far, the most utilized route in the WSF system.

Figure 9- Bainbridge Island/Seattle Ferry

SURVEY

The primary goal of the online passenger survey was to determine how many of the passengers onboard the ferries would want to use wireless Internet, how and where they would want the service provided, and how much they would be willing to pay for this service. A wealth of useful information was gathered during the survey period.

ONLINE

The survey was posted online at the Washington State Ferries website. Everyone on the WSF email alert list was notified of the survey. Riders were also able to access the survey independently from the Washington State Ferries website. Several local and national newspapers ran stories about the possible new service or included instructions on how to access the WSF passenger survey site. The survey was accessible from 09 December 2003 to 07 January 2004. During this time 2136 surveys were submitted and input into the Mobilisa database.
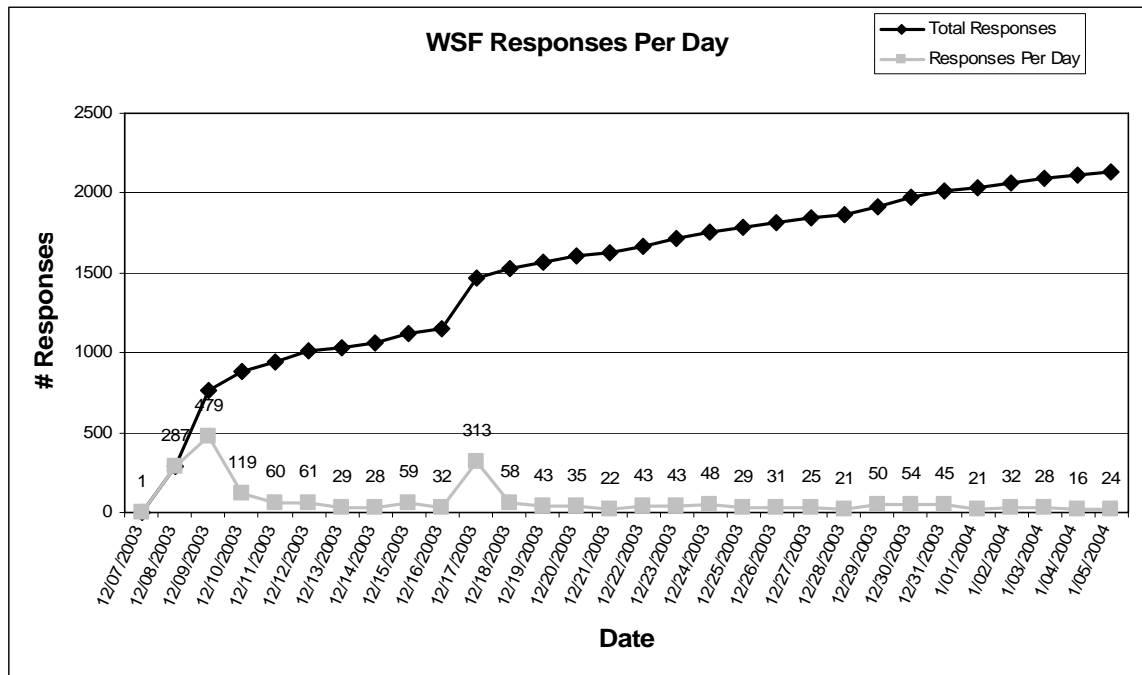

Figure 10-Survey Response Numbers

SURVEY ANALYSIS

DEMOGRAPHICS

The Washington State Ferries have 26 million rider events each year. Riders of the WSF have many different reasons for their patronage. Many passengers use it as a form of transportation to and from work or school. During the summer months, especially, it is a form of recreation. Many shipping companies use it to transport goods and services effectively across the Puget Sound.

Nearly half the respondents to our survey consider themselves regular commuters with the next largest percentage of respondents boarding a ferry 1-4 times per week. The most common boarding times were 6am-8am and 4pm-6pm. These are the busiest routes because they carry commuters to and from work. The routes with the highest number of respondents were the Seattle/Bainbridge 927 responses, Seattle/Bremerton 666 responses, and Edmonds/Kingston 545 responses. These three runs made up 58% of the total responses to this question. . This makes the data even more useful since those are three of the first four runs slated to receive wireless network installations.

USAGE

Types of Usage

Wireless Internet can serve several purposes and be used for several different operations. Respondents were given the option of making multiple selections from the following alternatives; web browsing, business/work, chat, email, music, news, other.

Of the respondents surveyed, the most popular uses were email, business/work, and web browsing. 79-90% of respondents indicated that these actions would be their top uses for the wireless Internet provided by the WSF. These are logical uses for the many commuters who use the ferries every day.

Equipment

Many devices are capable of accessing wireless Internet systems. These devices include laptop computers, Personal Digital Assistants (PDAs), PC phones, and smart phones. These devices use either built in or external wireless cards to connect to the wireless network. They all use internal batteries for power but are recharged by plugging into an electrical source.

91% of passengers responding to the survey own devices capable of accessing a wireless network. The most common device respondents stated they would use on the ferries was the laptop computer. 95% of those surveyed said that they would use their laptop computer while on the ferry, making this the device of choice for ferry riders.

WSF may also consider providing pay-per-use Internet kiosks aboard the ferries. These stations could be used by any passenger who wishes to access the Internet but does to have a device with the proper capabilities. These kiosks should have the ability to accept cash and debit or credit cards.

The use of Internet kiosks seems to be unpopular among survey respondents. 77% of the respondents to the survey said that they would not use a pay-per-use Internet kiosk. This could be because the majority of respondents have their own devices and would prefer to use their own equipment. Security concerns or concerns about availability may have contributed to the poor response.

USAGE AREA

There are several areas on land and aboard the vessels that are possibilities for wireless Internet usage. One of the goals of the survey was to determine where the passengers most wanted the wireless Internet available to them and where they were most likely to utilize it. It is in the best interest of the WSF to offer wireless Internet at the primary locations of use to the passengers.

The survey gave respondents the option of selecting multiple locations that they felt they would most use the system. The choices provided included, the parking area, holding/overflow area, terminal, car deck, main passenger deck, outside sundeck, and other. The main passenger deck was the most popular location for predicted Internet usage. 84% of respondents stated that they would use the Internet at this location on the ferry. The next most popular locations were the car deck and the terminal.

The WSF had already planned to provide wireless Internet in the main passenger cabin. The survey solidifies this decision as the most logical choice. If wireless Internet service will be offered in other locations the car deck and terminal are the next best choices.

SUBSCRIPTION

There are several different ways to subscribe to a wireless service like the one to be offered by the ferries. Passengers were asked to choose between a per-use subscription, and a monthly subscription. Respondents to the survey were fairly evenly split between the two options with per-use receiving 54% and the monthly subscription receiving 46% of the positive responses. Respondents were also asked to enter the amount they expected to pay for the service. The results of this question will be presented later in this document.

CUSTOMER ASSISTANCE

Many potential customers of the WSF system may be inexperienced with the set-up and operation of a wireless system. For this reason there will need to be assistance available to those who require it.

Help Desk

There will be a help desk located off site that users can access via a 1-800 number or through a customer help request website. Staff for the helpdesk will be well versed in Windows computing and PDA Operating Systems (OS), including Palm OS and Pocket PC. The staff will be available to assist users who are unable to connect to the network. Helpdesk staff will need to be able to instruct users in configuring their network settings but will limit their support to network connections.

The staff will not troubleshoot hardware problems, including resolving conflicts with other hardware when installing a wireless card; loading software drivers; or loading upgrades and patches to operating systems or browsers. Windows XP and Pocket PC can configure wireless cards automatically. It is recommended that the WSF limit support to current operating systems and browsers or make this software the user's responsibility to prevent help desk functions from escalating to functions not related to wireless networking.

FAQ

A Frequently Asked Questions (FAQ) document has been created to assist the riders with questions they may have regarding the system. It was viewable to passengers completing the online survey. This document gives definitions of Wi-Fi, hotspots, bandwidth, PDAs, TCP/IP, and VPNs. It also covers the possible equipment needed, the compatibility, and the range. The final version may include set-up instructions.

OTHER WI-FI USES

The wireless Internet system implemented in this project will be available for other uses in addition to customer wireless network access. These additional uses will benefit both customers and crew. It will improve service onboard ferries which will lead to a better customer experience and more efficient business practices.

GALLEY

When the galley is reopened, the wireless system will be able to be utilized by food vendors to allow them to accept debit and credit cards. This will improve customer satisfaction and transaction efficiency. Research has shown that accepting debit and credit cards increases the number of sales, and the amount of individual sales, so it is reasonable to expect that food sales and revenues to the ferry will increase.

In general, the average credit card user spends at least 25% more than cash buyers. Credit cards are extremely convenient for customers, especially when making impulse purchases. New technology has made it possible to speed credit card transactions through faster than cash. All this will result in increased revenue for WSF and food vendors, and added convenience for ferry riders.

ON SHIP SERVICES

The wireless system will improve onboard services that require communications connectivity. For example, the current onboard ATMs are often unusable due to malfunctions or lack of communications with ATM networks. The wireless network will improve ATM dependability and should increase ATM use among ferry riders.

With the implementation of the wireless service the ferry is considering the installation of kiosks. These could serve many different functions including offering wireless Internet service. These kiosks would need to accept cash, debit and credit cards..

SMART CARDS

WSF and the Seattle Metro Transit system are considering implementing a Smartcard system in the future. This would allow passengers to use one card to pay fares on all forms of public transportation, including ferries. This would simplify commuting and travel for riders.

The wireless system could interface with the fare card system. Riders would be able to add money to their Smartcard using the wireless system or kiosks.

PRICING

Wireless Internet access is offered by many different companies in many different locations all over the world. With so many different combinations of wireless services, the pricing structures are endless. When a company is considering offering wireless Internet access they must evaluate their clientele in order to decide upon the most effective pricing strategies.

CURRENT OFFERINGS

Some of the largest companies that offer wireless access and their pricing structures are:

Wayport:	Single Hotel	$9.95
	Single Airport	$6.95
	Prepaid Connections	
	3 connections	$25
	8 connections	$50
	20 connections	$100
	Annual	$29.95/month
	Monthly	$49.95
T-Mobile:	Unlimited National Monthly	$39.99
	Day Pass	$9.99
	Metered	$6.00/hour
		10¢ each additional minute

Surf and Sip	Annual	$20.00/month
	Monthly	$30.00
	1 Day	$5
	7 Day	$20
	30 Day	$40
	30 minute and 120 minute cards	$5/hour
Toshiba	1 hour	$4.95
	2 hours	$5.95
	1 Day	$7.95
	7 Day	$19.95
	30 Day	$39.95
Boingo	Monthly	$39.95
	Current promotion	$21.95 first 12 months
	1 Day	$7.95
	$7.95 setup fee	

Using these pricing charts, the mean amount charged per use is $5.68 and the per month mean amount is $39.97. If the Washington State Ferries wish to keep in step with the current market it is expected that they could charge $5.99 per use and $39.99 per month. These amounts, however, are not near the pricing suggested by the passengers surveyed, and described in paragraph 8.2.1 below. Customers often express unrealistically high or low pricing expectations as compared to the current market price when they respond to a survey.

CUSTOMER SUGGESTED OFFERINGS

The passenger survey included a section regarding subscription types and expected pricing. The responses to the subscription types were nearly equal, with 46% of respondents choosing monthly subscription and 54% of respondents choosing per-use subscription.

Those surveyed were also asked what price they would expect to pay for the subscription type they had chosen. Since respondents were allowed to enter responses, Mobilisa created normalization rules in order to include atypical responses. These rules were:

- If the respondent provided an upper and lower limit the mean was calculated.
- If the respondent indicated that they would prefer to pay by use and they list a time period, it was normalized to 1 hour.
- If the respondent indicated that they would prefer to pay by "day", the response was converted to 2 hours, assuming two trips per day.

Given these normalization methods the results of the pricing survey were as follows:

Monthly Subscription Amounts

Mean	$13.28
Median	$5.00
Mode	$10.00
Range	$0.00 to $100.00
Standard Deviation	$8.53

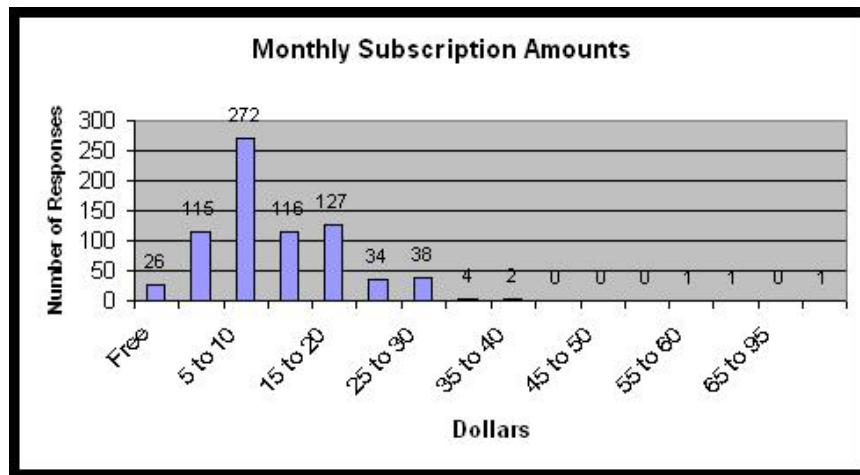**Figure 11-Monthly Subscription Responses**

Per-use Subscription Amounts

Mean $3.04

Median $5.00

Mode $1.00

Range $0.00 to $195.00
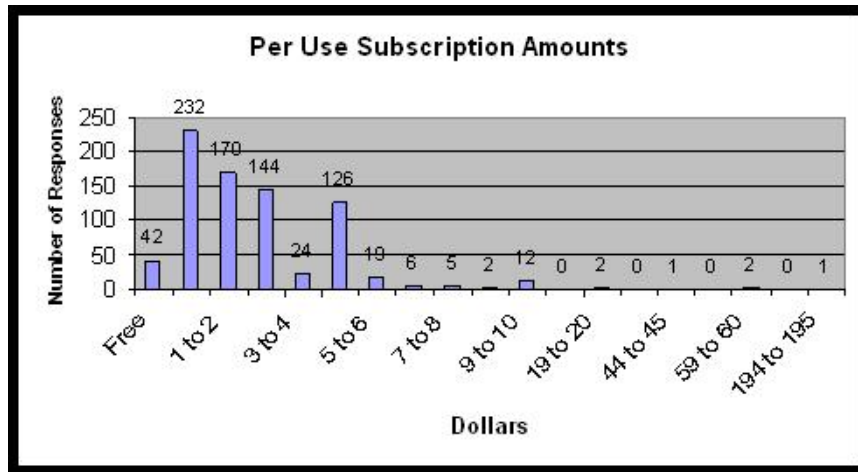
Standard Deviation $7.87

Figure 12-Per Use Subscription Responses

Suggestions Based on Survey Results

According to the results of the survey the mean amount suggested for a "per use" fee is $3.04 and for a "per month" fee is $13.28. If the ferries wish to charge an amount near this $3.99 per use and $15.99 per month is recommended. These prices, however, are below those currently offered by commercial Internet providers and may not be adequate to cover expenses.

PROPOSED OFFERINGS

An alternative to the ferries functioning as an Internet Service Provider (ISP), and one that we consider the best option for the WSF, is to allow users to connect to other services like Wayport, Boingo, or T-Mobile through a wireless network that would be maintained by a 3rd party on contract with WSF. This type of offering would allow customers to use any ISP that has an agreement with the WSF to offer service aboard the ferries. The WSF would then receive a royalty from the ISPs based on WSF customer usage.

One of the benefits of this option is that the customers could choose between multiple service providers or possibly use an ISP through which they currently have an account. This resolves the problem that the WSF could be limiting the usage for customers and ISPs. This is also advantageous to the ferries in that they are no longer responsible for support of the Internet. The WSF will not be required to supply any type of

support or help desk for the customers. All support will be provided through the ISP. This will drastically cut costs and eliminate much of the WSF responsibility.

With a 3rd party maintaining the network, the WSF simply has a flat fee each year to the contractor. This fee would be negotiated based on the number of routes to be implemented. The financing for this expense would come from the royalties gathered from the ISPs.

Through this option the Washington State Ferries are able to provide their customers with a better ridership experience while simplifying operations and reducing expenses.

COST BENEFIT ANALYSIS

COSTS

In Mobilisa, Inc.'s original proposal to the Washington State Ferries they outlined the costs for yearly operation of the wireless Internet service. The costs for yearly operation are as follows:

Labor	$223,384.00
Equipment	$ 50,000.00
Internet at Location	$ 8,400.00
Total	$281,784.00

This amount increases by roughly 10% for every 1000 users.

BENEFITS

All income will be derived from subscriber fees. For this analysis we will be using a standard monthly charge of $39.99. This is a standard monthly subscription amount charged by wireless companies like T-Mobile and Boingo.

BREAK EVEN

The break even point for this analysis is at roughly 600 users per year.
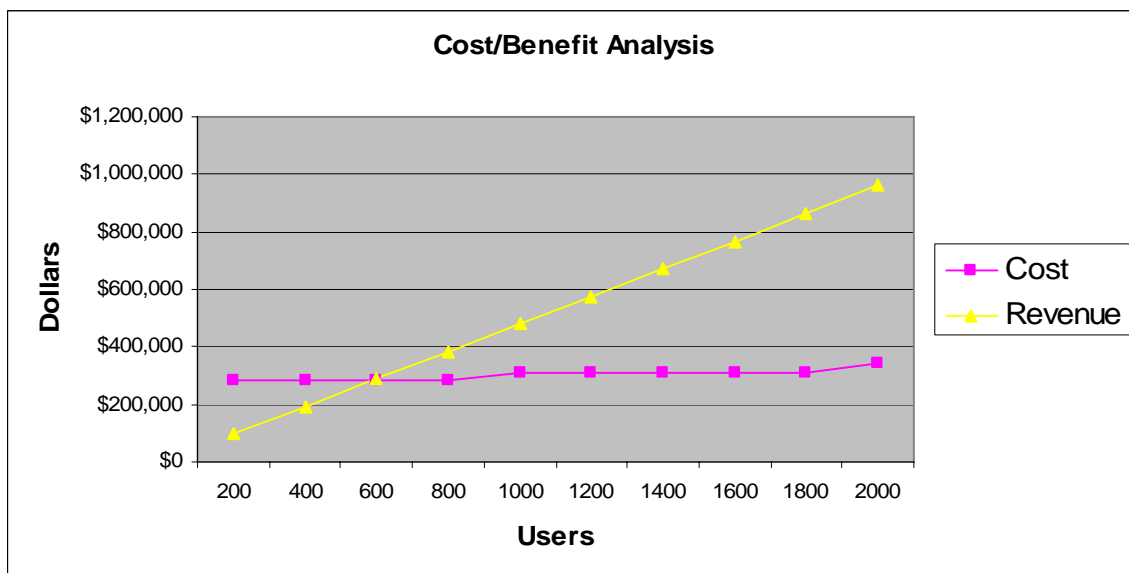
Figure 13-Cost Benefit Analysis

This analysis is based on the idea that the WSF would act as the Internet Service Provider. If the WSF chooses to enter into agreements with 3rd party ISPs, any cost/benefit analysis would be dependent upon the terms of each agreement. Therefore, we are unable to provide such analyses in this report.

END USER LICENSE AGREEMENTS

SUGGESTED TERMS AND CONDITIONS

Privacy and Censorship

If the ferries choose to become an Internet Service Provider, an end-user license agreement must be provided to users who subscribe. This agreement must address the issues of privacy and censorship. There will be no censorship performed on the websites or images users will be viewing. Passengers will be allowed to use this service in a public space in full view of others aboard the ferry. Their material has the potential to be viewed by other individuals aboard the ferry. It is illegal for persons to view explicit material in public, but it is not the responsibility of the WSF to regulate. If commercial ISPs are used, their policies apply. WSF may wish to publicize their policy on viewing materials that other passengers may find objectionable.

Usage Guarantee

There is no guarantee of the usage stability. There are several reasons why usage may be interrupted or temporarily unavailable that are beyond the control of Mobilisa, Inc., the Internet Service Providers or the WSF. The Internet could be temporarily blocked by an attack by a third party or there could be more users than the system can handle, causing slowness. There are also situations that are unique to waterborne vessels, including the possibility that another vessel may temporarily block the signal to and from the ferry. Another important obstacle when considering wireless Internet aboard the ferries is the weather. Abnormal weather or tides may cause the ferry to take an unusual route that is outside of the area covered by the antennas. For these reason there can be no guarantee placed on service time or usage.

Age

You must be 18 years of age to enter into a legally enforceable contract. Those passengers under the age of 18 will not be able to setup their own accounts.

Prices/Collections

Users should be notified that prices and Internet Service Providers available are subject to change without notice. New fees may be implemented by the Washington State Ferries without prior notice.

Termination

Internet access and use is at the discretion of the Internet Service Provider (ISP). The Washington State Ferries should reserve the right to terminate service at any time to any one user or group of users if they are the ISP. If viewing materials on the Internet causes a disruption on the ferry, WSF may want to reserve the right to terminate service even if other ISPs are providing the service.

CONCLUSION

Based on the information presented in this document we conclude that providing a wireless Internet system aboard the WSF is feasible and desired by the WSF passengers. The preferred method of providing this service is to allow passengers to connect to multiple Internet Service Providers (ISPs) that have agreed to offer service aboard the ferries. These ISPs would then pay royalties to the WSF for the added customer usage. The maintenance of the wireless Internet network would be performed by a 3rd party contractor to the WSF. This would provide the most choices for the customers and the most simplicity for the WSF.

One of the benefits of this method of operation is that the customers could choose between multiple service providers or possibly use an ISP through which they currently have an account. This resolves the problem that the WSF could be limiting the usage for customers and ISPs. This is also advantageous to the ferries in that they are no longer responsible for support of the Internet. The WSF will not be required to supply any type of support or help desk for the customers. All support will be provided through the ISP. This will drastically cut costs and eliminate much of the WSF responsibility.

With a 3rd party maintaining the network, the WSF simply has a flat fee each year to the contractor. This fee would be negotiated based on the number of routes to be implemented. The financing for this expense would come from the royalties gathered from the ISPs.

Dr. Chad Higgins, University of Washington Business School Professor, stated "As wireless networks continue to expand, the Washington State Ferries Wireless Connection Project provides the opportunity for WSF to be on the cutting edge of wireless technology. It is clear that there is demand for wireless service aboard the ferries and providing that service to passengers on routes throughout the Puget Sound will allow WSF to pursue their vision of being the most efficient and affordable, customer focused ferry operator in the world. Furthermore, providing a wireless network onboard the ferries aligns with the strategic goal of WSF to broaden their revenue base in order to continue offering the highest quality service in the future. Though the implementation of a Floating Area Network does have its' challenges, the opportunity to provide a more pleasant and productive passage to those using the services of the WSF is a commendable undertaking that will further highlight WSF as the premier ferry system in the United States."

With the technology supplied by Mobilisa the WSF will be able to fulfill the primary goals of this project, continuous connectivity and an improved rider experience.

WASHINGTON STATE FERRIES WIRELESS CONNECTION PROJECT EVALUATION SYNOPSIS

Project Background

Working closely with Washington State Ferries (WSF) and funded by a cooperative agreement from the Federal Transit Administration (FTA), Mobilisa, Inc. explored the feasibility of providing passengers on the WSF system continuous high speed internet access while at the dock and onboard the ferries, as a potential enhancement to the passenger experience. The FTA project sponsor, Charlene Wilder, and the WSF Program Sponsor, James Long, provided overall direction of the work.

The purpose of the Washington State Ferries (WSF) Wireless Connection Project was to research and develop ways to provide passengers of the system with continuous high-speed Internet access at the dock and onboard the ferries while en route. The two main objectives of this project were to improve the rider experience and to maintain a persistent Internet connection. This was accomplished by allowing passengers to access the Internet while waiting for or riding the ferries.

System Evaluation Summary

Over the course of a 12-month period, wireless network performance evaluations were conducted on the three separate ferry routes designated for the wireless pilot. Lockheed Martin Information Technology was selected to make a non-biased assessment of the proposed network design and installation completed by Mobilisa, Inc. The Evaluation Report details the evaluation criteria, testing procedures, and results of the evaluation. A sample survey and business case evaluation were also performed by Lockheed Martin Information Technology to validate the Business Case Study submitted by Mobilisa, Inc. These results are included in the report listed above.

The objective of the evaluation was to determine if the network design proposed by Mobilisa, Inc., for the Washington State Ferries (WSF) Wireless Connection Project met evaluation success criteria. The purpose of the Wireless Connection Project was "to provide passengers of the WSF system continuous high-speed Internet access at the dock and onboard ferries while en route to enhance the user experience." The evaluation consisted of two primary criteria.

The first and foremost evaluation factor was the overall rider experience. The evaluation presents a more qualitative analysis rather than a quantitative analysis. The rider experience will be discussed in more detail as it relates to the various technologies evaluated and discussed in the evaluation document itself.

The second evaluation factor was to maintain a persistent connection to the vessel during the entire route. The persistent connection was viewed from two perspectives. The primary perspective is the ability to maintain a connection to the Internet during the entire route, regardless of the overall available bandwidth to the vessel. The secondary perspective, which directly affects the rider's experience, is the ability to maintain an adequate amount of bandwidth to the vessel during the entire route.

What started out as a "Proof-of-Concept" project has far exceeded initial expectations, and has developed into a fully functioning mobile and wireless high-speed Internet system that functions in a marine environment. Washington State Ferries customers are very pleased with the system.

Passenger Survey Results

The sample passenger survey conducted by Lockheed Martin Information Technology during peak commuter traffic periods suggested that the user experience was improved for the passengers using the wireless service. Out of 210 survey responses, 79% of passengers rated the service at 5 or above on a scale of 1 to 10. A very large portion of the passengers felt that the wireless service was acceptable or better.

Business Case Evaluation

The Business Case Study demonstrated that WSF passengers would like to have a wireless Internet system onboard the ferries and that the volume of users is sufficient to justify further development. It also demonstrated that the system would be most effective by allowing passengers to connect to multiple Internet Service Providers (ISPs), have ISPs pay royalties to the WSF, and have WSF pay maintenance to a third-party (neutral) contractor. This conclusion appears reasonable, but more information is required to validate the financial feasibility and service pricing.

Conclusion

Overall, Lockheed Martin Information Technology evaluators were impressed with the technical hurdles this pilot had to overcome to provide wireless Internet access onboard a moving vessel across the Puget Sound.

It is recommended that the system be expanded to include all of Washington State Ferry routes and terminals, with particular emphasis on the other daily commuter routes. The technology has proven to be successful and the demand from the customers is very promising.