

Washington State Ferries Wireless Connection Project

FINAL REPORT

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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

" 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

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.

BACKGROUND



Fig 2 - WSF ferry routes

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 thirty 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.

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.

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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.

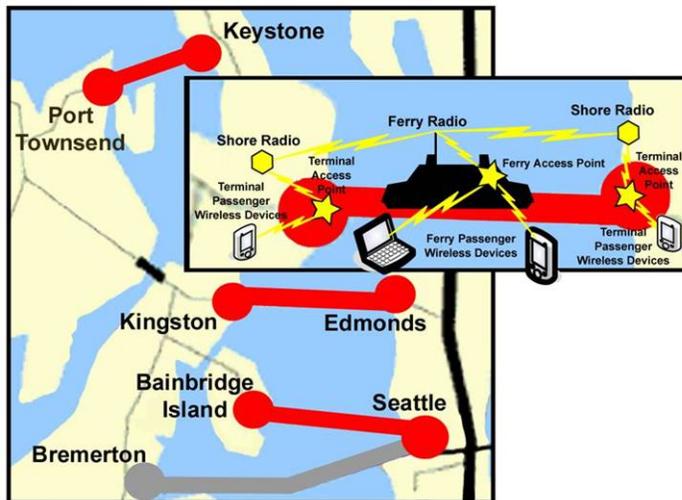


Fig 3- Basic project diagram

"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 entirety 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.

*“This is an amazing bridge
of productivity between
destinations.
I love the commute
downtime between
destinations, but I also use
my PC for everything,
including reading books.
The service has literally
brought the 21st Century to
a very traditional space.
Way to go DOT!”
-Ferry User*

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.

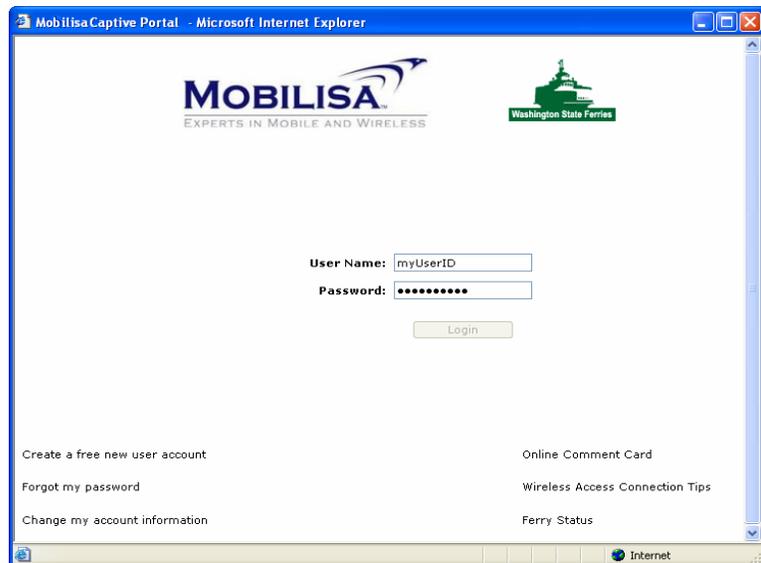


Fig 5 - WSF WCP login screen

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.

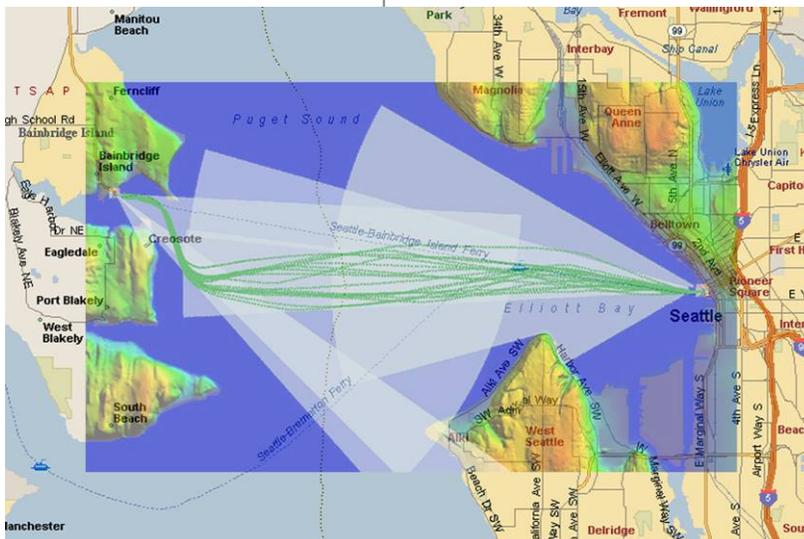


Fig 7 – “Ping Plot” coverage map of Seattle Bainbridge route

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

5. Third Party Evaluation

6. Support

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.

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.

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.

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.

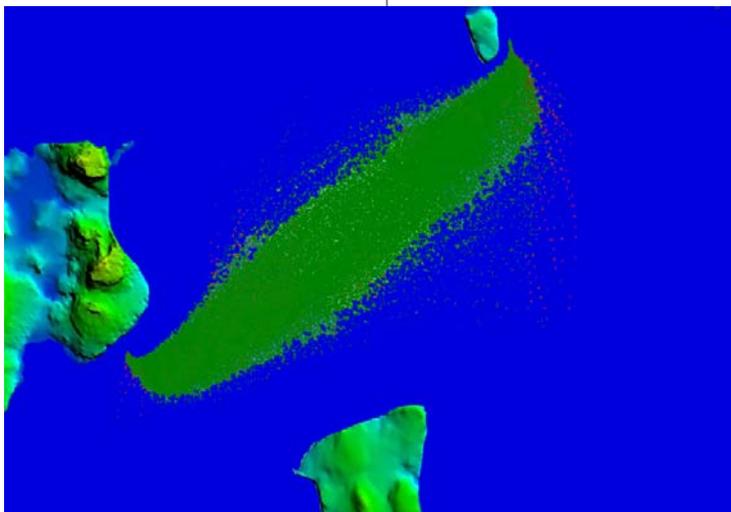


Fig 8 – “Ping Plot” coverage map of Port Townsend Keystone route

DISCUSSION

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

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

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.

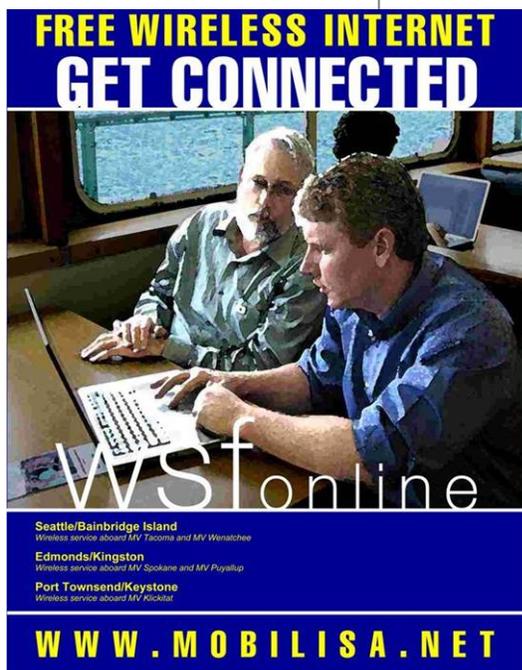


Fig 9 – “Get Connected” WSF WCP poster

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 be strongly considered.

Acknowledgements

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