October 15, 2007

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: Ensc 440 Project Functional Specification for a Wireless Waiter Calling System

Dear Dr. Rawicz,

The attached document provides the functional specification for our proposed project for ENSC 440. The aim of our project is to implement a wireless waiter caller system for customers in spread out dining establishments.

This document provides an overview of the different requirements for our SerCal System's functionalities in both the proof-of-concept and production phases of development.

Our company, SWIS, consists of four talented individuals: Aron McKinnon, CEO; Raymond Tan, CTO; Peter Chen, VP Quality Assurance. We believe this team is capable of accomplishing the proposed task in a timely fashion.

If you have any questions or concerns, please do not hesitate to contact us at ensc440-swis@sfu.ca

Sincerely,

Aron McKinnon
Chief Executive Officer

Short-range Wireless Innovative Solutions

FUNCTIONAL SPECIFICATIONS

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Executive Summary

How many times have you sat at a restaurant, pub, or other sit-in service establishment and wished you had an easy and fast way to communicate to the waiter? This problem is major and plagues the hospitality industry, resulting in aggravated patrons, under-tipped waiters and low quality establishments. Fortunately, this problem has been solved by SWIS with its one of a kind product: SWIS Server Caller (SerCal). Overall, SWIS engineers are determined to solve the potential demand for this and other short-range wireless communication solutions.

The SerCal system works by having a transmitter with a call button placed at each table and the waitress having a transceiver unit that quietly and conveniently conveys which tables require her attention. The waiter will also be able to convey orders and updates real time to the kitchen via her portable transceiver set. The paging system is a win-win design that pleases everyone! The patrons get prompt service, the waitress is able to service their customers more efficiently and effectively; thus receiving higher tips, and the restaurant owners get a cost-effective solution to a better-managed working environment that attracts more customers, thus increasing profitability.

Figure 1. SerCal Operation

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1.0 Introduction

The SWIS Server Caller (SerCal) is a paging system for restaurants and pubs. The system allows restaurant/pub patrons to electronically “call” their server to let the server know that the patron is in need of assistance or ready to order. The system would consist of a transmitter unit placed discretely on every table, and a portable transceiver unit carried by the server. When a patron presses the transmitter unit, the server would be notified on his/her transceiver unit that a particular table needs his/her attention. The transmitter unit could be decorated to display a sign or menu item. The transceiver unit carried by the server allows the server to know which tables require assistance in a simple glance.

1.1 Scope

This document describes functional requirements that must be met by the fully functional prototype of the SWIS SerCal. The requirements are divided into phase one and phase two requirements. A complete set of requirements for phase one are listed in this document. However, for phase two the requirements are loosely defined as it is expected that a substantial amount of revisions and modifications will be made during the phase one development stage.

1.2 Glossary

AC Alternating Current

BER Bit Error Rate

CSA Canadians Standards Association

dBm Power level in decibels per 1 milliwatt

EMC Electromagnetic compatibility

FAQ Frequently asked questions

FCC Federal Communications Commission

GUI Graphic user interface

UI User interface

IEC International Electrotechnical Commission

ISM The industrial, scientific and medical radio bands

PDA Personal Digital Assistant

SerCal Restaurant Server Calling System

SWIS Short-range Wireless Innovative Solutions

TSCS Table-Server Communication Subsystem

SKCS Server-Kitchen Communication Subsystem

1.3 Intended Audience

This document is intended for design engineers, project managers, and marketing personnel. Design engineers may use this document as a guideline for the development of this system. Project Managers may use this document as a guide for scheduling, budgeting, planning, and other management activities relating to the development of the SWIS. Marketing personnel may use this document for promotional purposes and for attracting investors.

1.4 Convention

The following convention will be used throughout this document for assigning priority to functional specifications:

R[n/priority] Functional specification description.

The functional specification number is denoted by n. The priority is given by A, B, or C and is displayed after the functional specification description. The priority alphabet convention is as follows:

A: Functional specification is required for both the proof of concept, and the final production system.

B: Functional specification is for just the proof of concept.

C : Functional specification is for just the final production system.

2.0 User Interaction Functional Specifications

This section will discuss the different groups of users, how they interact with one another, and finally how they interact using our SerCal System. Discussing the different user groups for the SerCal is important because it will have to work correctly with all of the three user groups for it to integrate into a restaurant environment. The following three subsections will discuss the interaction functional specifications for each user group.

The first user group is the ***customers***. The customer is the person who is requesting the server and is in at a restaurant table where our SerCal system is installed.

The second group of users is the ***restaurant servers***. The restaurant servers consist of all individuals whose job entails providing service to the Customers (waiters, waitresses).

The last user is the ***kitchen staff.*** The kitchen staff consists of all individuals whose job entails preparing the food and beverages used in the restaurant environment (chefs, bartenders, etc.).

Figure 2 illustrates the relationships between all the different user types.

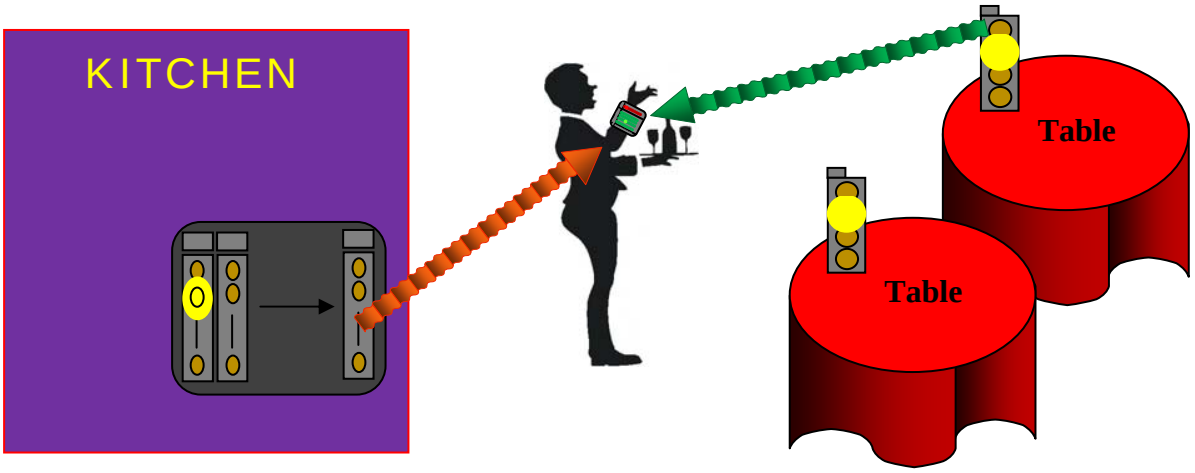

Figure 2: User Interaction

2.1 The Customer

R[1/A] The Customer interacts with the SerCal system only through the UI attached to the Table Unit.

R[2/A] The UI will indicate that they have successfully been pressed to the customer.

R[3/A] The Customer should be able to indicate he is requesting multiple service.

R[4/A] The UI should indicate when the server has addressed the customer's request

2.2 The Server

R[5/A] Can turn the UI indicator on the Table Unit off, indicating that the request has been addressed.

R[6/A] Will be notified which table is requesting

R[7/A] Will be notified what the requesting table is requesting (drink, bill, food, come to table, etc.)

R[8/A] Can notify the kitchen staff which table is making a order

R[9/A] Can notify the kitchen staff what the customer orders (beer, nachos, etc.)

R[10/A] Can view on his/her portable unit which table's food is ready from the kitchen staff.

2.3 The Chef / Kitchen Staff

R[11/A] Can view which table requires items

R[12/A] Can view what the customer orders (beer, nachos)

R[13/A] Can indicate to server when the ordered items for a specific table are ready for pickup

3.0 System Requirements

3.1 System Overview

Phase One System Overview

Phase One is the development of the entire system but with only short range transmissions. The server unit will allow the server to transmit and to receive in a radius of around ten meters. On the other hand, the table unit will have a minimum number of options in the UI.

Phase Two System Overview

In Phase Two, the table unit will consist with more options and longer transmission range. The server unit will also have an increased transmission radius. The server unit will also include alarms that will notify the server a request has been made. So that even if the server is really busy and has no time to check the server unit, he/she will still know that he/she is needed.

SerCal System:

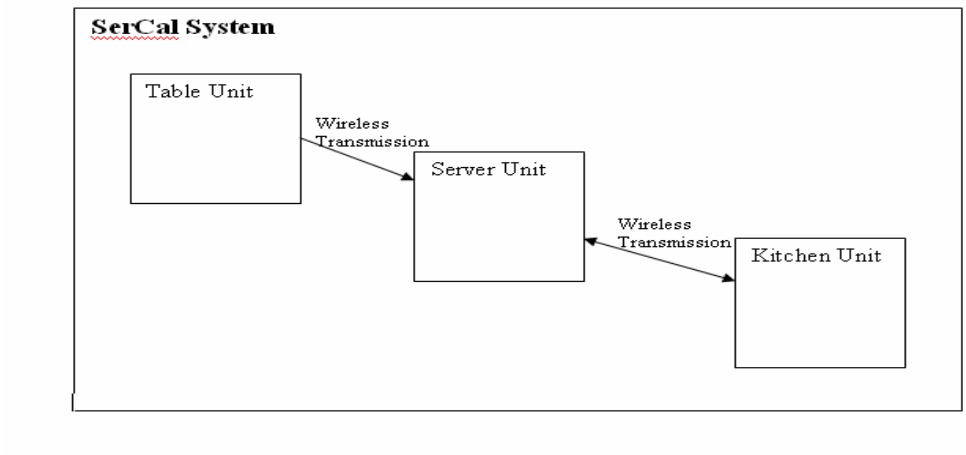

Figure 3: System layout

Name	Description
SerCal System	This is the name of our short range wireless communication system. It consist of three SerCal units, the Table Unit, Server Unit and Kitchen Unit.
Table Unit	The SerCal unit located at each customer's table
Server Unit	This SerCal unit is a portable transceiver unit carried around by a server (waiter/waitress) which communicates with both the Table Unit and Kitchen Unit.
Kitchen Unit	The SerCal Unit located in the kitchen that receives wireless updates from the Server Unit.

Table 1: Definition of terms in system overview

3.2 Table Unit

The Table Unit consists of an UI and is connected wirelessly to the Server Unit to inform the server when a customer makes a request. A scheme will be implemented to ensure the conveyance of button press data is transmitted in a reliable manner to a Server Unit.

The functional requirements for the Table Unit are as follows:

3.2.1 General Requirements

R[14/B] Table Unit will consist of at least two options on the UI to show proof of concept with multiple options

R[15/C] Number of options will be increased in order to accommodate restaurant needs.

R[16/B] Prototype will consist of at least two Table Units to show proof of concept with multiple Table Units.

R[17/C] Number of Table Units will be increased in order to accommodate restaurant needs.

R[18/A] Each Table Unit will communicate independently of one another with the Server Units to ensure system reliability.

R[19/A] Different options on the Table Unit will not interfere with each other.

R[20/A] Table Unit shall not interfere with any restaurant /electronic equipment.

R[21/A] The Table Unit will be robust and reliable.

3.2.2 Physical

R[22/C] The wireless interface of the Table Unit shall be no larger than a length of 15cm, width of 10cm, and a thickness of 10cm in order to be portable and conserve space for the table.

R[23/C] The casing encompassing the wireless transmitting module will be rigid and be able to withstand compression stress.

R[24/A] The casing shall be made of a non-toxic material, in order to not harm the users.

R[25/C] The casing will not have any sharp edges in order to not harm the user.

R[26/A] The Table Unit will be able to operate properly under normal atmospheric pressure. Operation of the SerCal under abnormal atmospheric pressure will not be supported.

3.2.3 Accuracy

R[27/A] Table Unit signals shall not be affected by external noises such as electro-magnetic, thermal, and acoustic noise.

R[28/A] The transmitted information should not lost during transmission.

3.2.4 Performance

R[29/A] The electronics in the wireless sensor module will be able to withstand temperature that exists in a normal restaurant environment ranging from 0-45°C.

3.2.6 Power

R[29/A] The Table Unit shall be self powered.

R[30/C] The Table Unit shall not dissipate any detectable heat by the customer during its operation.

3.2.7 User Interface

R[31/A] The UI on the Table Unit will only require one hand to access all the functionality of the module.

R[32/A] The Table Unit UI will turn on a visual indicator when data is being transmitted (a request is made to server).

R[33/A] The UI on the Table Unit will be easy for customers to use.

3.2.8 Maintainability

R[34/C] The customer will at no point need to service or repair the module.

R[35/C] Only trained personnel will be able to service the device.

R[36/C] Documentation will be provided in order to service this module.

3.2.9 Data Storage

R[37/A] If the sensor module fails to receive a verification of the data it sent, the data will be stored in onboard memory until the Server PDA Unit requests the data to be retransmitted.

R[38/A] Data will be erased from the memory on the sensor module upon receiving verification from the PDA in order to prevent the need for large onboard storage.

3.2.10 Communication

R[39/A] The information transmitted should be short to reduce storage and transmitting time.

3.3 Server Unit

The functionality of the server unit is to gather all information sent to it wirelessly from the wireless Table Units and the Kitchen Unit. The Server Unit will initiate a connection to each Table Unit wirelessly, and will request data from each of them. A verification scheme will be implemented in the Server Unit to ensure that all packets that are transmitted from the wireless Table Units will be received by the microprocessor of the Server Unit, unmodified. The functional requirements for the Server Unit are as follows:

3.3.1 General Requirements

R[40/B] The Server Unit will have at least two options in the UI to show prove of concepts.

R[41/C] Number of options will be increased in order to accommodate restaurant needs.

R[42/B] Prototype will consist of at least two Server Units to show proof of concept with multiple Server Units.

R[43/C] Number of Server Units will be increased in order to accommodate restaurant needs.

R[44/A] Each Server Unit will communicate independently of one another with the Kitchen Units and Table Units to ensure system reliability.

R[45/A] Server Unit shall not interfere with any restaurant /electronic equipment.

R[46/A] The Table Unit will be robust and reliable.

R[47/A] The Server Unit must be portable and easily carry around by servers.

3.3.2 Physical

R[48/C] The Server Unit should not be larger than a commercial PDA.

R[49/C] The Server Unit should be water-proof and scratch-proof.

R[50/A] The casing shall be made of a non-toxic material, in order to not harm the users.

R[51/C] The casing will not have any sharp edges in order to not harm the user.

R[52/A] The Server Unit will be able to operate properly under normal atmospheric pressure. Operation of the SerCal under abnormal atmospheric pressure will not be supported.

3.3.3 Performance

R[53/A] The electronics in the Server Unit will be able to withstand temperature that exists in a normal restaurant environment ranging from 0-45°C.

3.3.4 Power

R[54/A] The Server Unit shall be self powered.

R[55/C] The Server Unit shall not require a lot of power recharge during each shift.

3.3.5 User Interface

R[56/A] The UI on the Server Unit will only require one hand to access all the functionality of the module.

R[57/A] The UI on the Server Unit will be easy to use and easy to learn.

3.3.6 Serviceability

R[58/C] The Server Unit should be easy enough to service (ex. Replace battery, reset) ,that it should be able to be serviced by a restaurant server.

3.3.7 Communication

R[59/A] The information transmitted should be short to reduce storage and transmitting time.

3.3.8 Data Storage

R[60/A] The Server Unit should store which customer ordered what.

3.4 Kitchen Unit

The functionality of the Kitchen Unit is to gather and send information wirelessly to and from the wireless Server Units. The functional requirements for the Server Unit are as follows:

3.4.1 General Requirements

R[61/B] The Kitchen Unit will have at least two options in the UI to show prove of concepts.

R[62/C] Number of options will be increased in order to accommodate restaurant needs.

R[63/A] The Kitchen Unit shall not interfere with any restaurant /electronic equipment.

R[64/A] The Kitchen Unit will be robust and reliable.

3.4.2 Physical

R[65/C] The Server Unit should not be larger than a commercial desktop computer.

R[66/C] The Server Unit should be water-proof.

R[67/A] The casing shall be made of a non-toxic material, in order to not harm the users.

R[68/C] The casing will not have any sharp edges in order to not harm the user.

R[69/A] The Server Unit will be able to operate properly under normal atmospheric pressure. Operation of the SerCal under abnormal atmospheric pressure will not be supported.

3.4.3 Performance

R[70/A] The electronics in the Server Unit will be able to withstand temperature that exists in a normal kitchen environment ranging from 0-60°C.

3.4.4 Power

R[71/A] The Kitchen Unit should be powered with external power.

3.4.5 User Interface

R[72/A] The UI on the Kitchen Unit will only require one hand to access all the functionality of the module.

R[73/A] The UI on the Kitchen Unit will be easy to use and easy to learn.

3.4.6 Serviceability

R[74/C] The kitchen Unit should be easy enough to service (ex. Replace battery, reset) ,that it should be able to be serviced by a restaurant server.

3.4.7 Communication

R[75/A] The information transmitted should be short to reduce storage and transmitting time.

3.4.8 Data Storage

R[76/A] The Server Unit should store orders.

3.5 Wireless Communication Requirements

This section outlines the functional requirements for the wireless communication

between the different SerCal Units.

3.5.1 Transmission Range and Radius

R[77/B] Wireless transmission radius is 10m centered about the Server Unit to illustrate proof of concept for wireless data transmission from the Table and Kitchen Units.

R[78/C] Wireless transmission radius will be increased in reference to R[95].

3.5.2 Interference Requirements

R[79/C] Wireless transmission will not interfere with external electronic equipment.

R[80/A] Shall minimize co-channel interference.

R[81/A] Shall minimize effect of multi-path.

R[82/A] Wireless transmissions shall not interfere with the SerCal Units' internal components (crystals, power supply, etc.).

R[83/A] Shall minimize crosstalk.

R[84/A] Wireless transmission from one SerCal Unit will not interfere with transmission from another SerCal Unit.

R[85/A] Two SerCal Units will not interfere with each other.

3.5.3 Transmission Power

R[86/A] Shall be no more than 1mW (0dBm) nominal [6].

R[87/A] Transmission radiation will not be harmful to the user and the surrounding.

3.5.4 Transmission Characteristics

R[88/A] Will only operate in FCC regulated frequency band for restaurants .

R[89/A] Signal will have a bandwidth which will comply with FCC regulations.

R[90/A] Will be able to support multi-point transmission.

R[91/A] Transmissions between Table and Kitchen Unit to the Server Unit shall be able to occur in parallel.

R[92/A] Wireless transmission will have an average BER of 10^{-6} which is an acceptable BER [11].

R[93/A] Wireless transmission will have a maximum of 1% packet loss.

R[94/A] 99.9 % of all data to be processed after verification will be correct; that is, it will be the same data that was transmitted by the different SerCal Units.

4.0 Regulatory Requirements

The SWIS SerCal System will comply with the following standards:

R[95/C] Title 47, chapter 1 (Federal Communications Commission), section 18 of the Code of Federal Regulations regarding ISM device requirements.

R[96/C] Title 47, chapter 1 (Federal Communications Commission), section 15 of the Code of Federal Regulations regarding Radio Frequency devices.

R[97/C] The standards set forth for medical devices by the U.S. Food and Drug Administration Center for Devices and Radiological Health.

5.0 Documentation Requirements

5.1 General

R[98/C] There will be three different manuals: a patient instruction, Healthcare Worker instruction, and technician instructions.

R[99/C] Additional information and documentation will be provided on the SWIS website and will consist of user documentation and FAQs, as seen necessary.

R[100/C] Users of the proof of concept device will be instructed by SWIS engineers, or use the device under the supervision of SWIS engineers.

R[101/C] All three versions of the documentation will be written in English.

5.2 The Customer

R[102/C] The customer manual will be written for an audience with minimal technical expertise; it will consist of a one page leaflet document with proper instrument care, and sensor placement information.

5.3 The Sever

R[103/C] The Server worker manual will be written for an audience with general experience with electronics device; it will provide training for complete device usage for two modules: Table Unit and Server Unit

5.4 Kitchen Staff

R[104/C] The Server worker manual will be written for an audience with general experience with electronics device; it will provide training for complete device usage for the Kitchen Unit

5.5 The Technician

R[105/C] The service crew manual will be written for an audience with expertise in electronic device setup; it will provide complete training, setup, troubleshooting, and device characteristics information for all three modules: Table Unit, Server Unit and Kitchen Unit.

6.0 Testing Plan

The SerCal system will be divided into individual components and communication subsystems to be tested prior to integration. During integration, further testing will be conducted in order to ensure that proper communication and operation occurs between the three modules for the final integrated solution. Because the testing procedures will be complex and specific to the independent type of technologies used, a brief overview for the test plan for each phase of development is described below. In addition to this testing, further tests will be conducted in order to ensure that the final solution will meet the safety standards and regulatory requirements. Upon meeting the proof of concept criteria, we intend to subject the completed prototype to a live test in an actual restaurant or pub.

6.1 Phase one Test Plan (Individual components)

Before any form of integration is done, testing of each individual sub component of the SerCal system is necessary in order to isolate faults and make subsequent debugging of the integrated system easier. A list of tests for each individual components are as follows.

6.1.1 Table Unit

A list of test for an individual table unit are as follows:

- Power Supply Test
- Button press indication test
- Button reset indication test
- Button press and correct wireless output serial data sent
- Button reset and correct wireless output serial data sent
- Test duration of signal sending

- Multiple button press test

6.1.2 Server Unit

A list of test for an individual Server Unit are as follows:

- Power Supply Test
- Integration with a handheld device (eg. PDA)
- Successful execution of SerCal executable program
- Ability to scan for incoming signals
- Ability to send out correct, unique signal for each intended message
- Ability to send packets of data continuously (rate and message integrity)
- Test duration of signal sending

6.1.3 Kitchen Unit

A list of test for an individual Kitchen Unit are as follows:

- Power Supply Test
- Integration with a Graphic User Interface (GUI) (eg. Laptop)
- Successful execution of SerCal executable program
- Ability to scan for incoming signals
- Ability to send out correct, unique signal for each intended message
- Ability to send packets of data continuously (rate and message integrity)
- Test duration of signal sending

6.2 Phase Two Test Plan (Wireless communication for subsystems)

The SerCal system, consisting of three different SerCal units, will have two communication subsystems. These are namely the Table-Server communication subsystem (TSCS) and the Server-Kitchen communication subsystem (SKCS). While the TSCS is a unidirectional wireless line from a Table Unit to a Server Unit, the SKCS is a bidirectional wireless line between a Server Unit and a Kitchen Unit. A list of test for each communication subsystem is as follows:

6.2.1 Table-Server Communication subsystem

A list of test for this communication subsystem are as follows:

- Wireless connection establishment test
- Device and Data level hand shake test
- Unidirectional transmission of data from Table Unit to Server Unit
- Correct encoding of wireless data sent out by Table Unit
- Integrity and accuracy of data sent.
- Correct decoding and display of wireless data received by Server Unit
- Rate of data transmission
- Multiple data transmission/reception from one Table Unit(sequentially)
- Multiple data transmission/reception from multiple Table Units (two for proof of concept)
- Cancellation of service request on Server Unit upon resetting buttons on the Table Unit
- Range of wireless communication (for proof of concept)
- Power consumption of SerCal units during communication

6.2.2 Server-Kitchen Communication subsystem

A list of test for this communication subsystem are as follows:

- Wireless connection establishment test
- Bidirectional Device and Data level hand shake test
- Unidirectional transmission of data from Server Unit to Kitchen Unit
- Correct encoding of wireless data sent out by Server Unit
- Integrity and accuracy of data sent.
- Correct decoding and display of wireless data received by Kitchen Unit
- Rate of data transmission
- Multiple data transmission/reception from Server Unit(sequentially)
- Range of wireless communication (for proof of concept)
- Power consumption of SerCal units during communication
- Repetition of all the above steps in this subsection for reverse direction of data flow (ie. From Kitchen Unit to Server Unit)

6.3 Phase Three Test Plan (Integrated System Test)

Here, we finally put all the three different SerCal units together and observe how the two communication subsystems and three individual components work concurrently. A list of tests for the integrated system are as follows:

- Wireless connection establishment test
- Repetition of all steps in 6.2.1 and 6.2.2 in the presence of all 3 SerCal Units
- Ensure no interference/data corruption between the 2 communication subsystems (TSCS and SKCS)
- Ensure no external interference with local SerCal system
- Range of wireless communication for entire system (for proof of concept)

6.4 Phase Four Test Plan (Live Integrated System Test)

The objective of this phase of the test is to expose any additional bugs and limitations of the SerCal prototype system might have slipped through the first 3 phases of tests. During this phase, the SerCal system will be subjected to many actual scenarios in a restaurant and observations will be made on how well the SerCal handles these possible scenarios. Upon detection of system behaviour which does not correspond with the functional specifications, additional debugging will be performed to correct the error.

7.0 Conclusion

The functional specifications provided in this document specify the functionality that a properly operating SerCal system should have. Specifications, which are intended to be implemented by early December 2007, have been laid out in a priority convention for requirements throughout.

Testing overview and strategy give comprehensive testing plans to determine if our proof-of-concept device is complete. Also, because our product is used in a restaurant environment, complete regulatory requirements have been specified so the final product will comply with FCC, and safety regulations.

Further information regarding all aspects of the SWIS can be acquired from our CEO, Aron McKinnon, at amckinno@sfu.ca.

8.0 References

Regulatory Requirements

1) http://www.ce-mag.com/archive/03/ARG/emc_standards.html

Miscellaneous

2) http://www.ensc.sfu.ca/~whitmore/courses/ensc305/

Short range wireless products:

3) http://www.rfglobalnet.com/Content/ProductShowcase/product.asp?DocID=%7B1CA7905E-819E-4492-AA1B-0C8D92439F3A%7D

4) http://www.aerocomm.com/rf_transceiver_modules/zb2430_zigbee_your_way_transceiver.htm

5) http://www.aerocomm.com/rf_transceiver_modules/ac4424_24ghz_rf_transceiver.htm

6) http://www.aerocomm.com/rf_transceiver_modules/ac5124_24ghz_rf_transceiver.htm

7) http://www.rfglobalnet.com/content/productshowcase/product.asp?docid=91391c7e-78c4-48f7-ad47-5553de6d73d2

8) http://www.rfglobalnet.com/ecommcenters/nordicvlsi.html

9) http://www.emergentelectronics.com/RFModules.html

10) http://xecom.com/datasheets/XE24S500.pdf

11)http://www.commsdesign.com/showArticle.jhtml;jsessionid=HME2YKS5IVNMQQSNDLRSKH0CJUNN2JVN?articleID=175803410

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12) http://www.electronicproducts.com/ShowPage.asp?SECTION=3130&PRIMID=&FileName=aprHL3.apr2001

13) http://www.hobbyengineering.com/H2037.html

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