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February 16, 2009

Mr. Steve Whitmore
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

RE: ENSC 440 Functional Specifications for Watchbird™ Home Monitoring System.

Dear Mr. Whitmore,

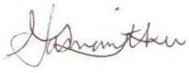
"The Watchbird™ Remote Peace of Mind System: Functional Specifications", attached to this letter, outlines the requirements for the Watchbird™ system.

This functional specifications document first presents an overview of the Watchbird™ system and breaks up the system into several key components. It then introduces several requirements for the complete system before presenting the requirements for each of the system's components. Each set of requirements is broken up into several categories (e.g. physical, electrical, and safety) for quick reference.

The document then presents the first part of Chickadee Tech's test plan, which generally describes how we will test the prototype and the production model to ensure that each of the requirements is met. The second part of the test plan will be given in the design specification, when more specific test criteria can be determined.

Please let me know if you have any questions, comments, or concerns about this document. I can be contacted at 604.837.4009 or by email (smg2@sfu.ca). Thank you very much for your time in reviewing these requirements.

Regards,



Samantha Grist
President
Chickadee Tech

The Watchbird™ Remote Peace of Mind System:

Functional Specifications

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February 16, 2009

Executive Summary

Security companies have pioneered the technology for real time home protection. Using sensors and alarms, they ensure the safety of homes through their constant surveillance. Even though the technology and services exist, this method requires a paid third party to maintain, and actual homeowners are generally not aware of the situation at home until they return there. Chickadee Tech aims to provide homeowners with a home monitoring system that gives users full control over maintaining home safety without fees. This monitoring system, known as Watchbird™, will offer users the ability to remotely monitor their home and control the locks of the doors using simple cell phone text messages.

As outlined in this document, Watchbird™ will be made up of several components, each of which will be built to satisfy strict physical, electrical, performance, usability, and safety requirements and standards. The system as a whole will also need to satisfy many requirements. This document presents these requirements in their entirety, and will be used to guide further development of the system.

Development of Watchbird™ will proceed in two phases. In the first phase, a prototype that meets one set of the functional requirements described in this document will be realized by April 2009. With the concept proven, the second phase of the development, the production phase, will begin where Chickadee Tech will explore options for cost reduction and optimize Watchbird™ to meet market demand.

After each phase is completed, the model (prototype or production) will be tested to ensure it satisfies all of the necessary requirements. The general test plan for the Watchbird™ system is also presented in this document.

Upon the completion of Watchbird™ development, Chickadee Tech will be ready deliver an innovative and user-friendly home monitoring system to homeowners.

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1. Introduction

1.1. Background

Chickadee Tech has proposed to develop a remotely accessible home monitoring system called Watchbird™. The system will allow users to check via cell phone on the status of door locks, windows, or stoves in their homes. Statistics quoted in the project proposal indicate that a considerable percentage of people leave their homes without locking their doors [1], and that many burglaries actually occur through an unlocked door [2]. Watchbird™ will provide users with peace of mind in an unobtrusive and low-cost manner.

1.2. Purpose

This document will clearly define the problem encompassed by a home monitoring system, and will identify the functional requirements of the Watchbird™ system. In their analysis, Chickadee Tech has considered company members' own homes to determine what a monitoring system in a typical home would require in terms of usability, reliability, security, operating conditions, power consumption, and size.

This document will then be used by all members of Chickadee Tech as they develop design specifications and a working proof of concept system.

1.3. Numbering System

Chickadee Tech aims to demonstrate their prototype in April of 2009. At this point, the system will meet the specifications deemed critical for a proof of concept. However, production level considerations such as an independent system for relaying SMS (short message service) text messages, a secure method of data encryption, and a high-traffic server will not be present in the prototype.

The functional specifications listed in this document are labeled to reflect these differences. All specifications are of the form *[FS-x-Y]*, with *FS* meaning "functional specification" (distinct from future design specifications), *x* numbering the specification, and *Y* labeling its development category as follows:

I – prototype and production level,
II – production level only,
III – prototype level only.

2. Full System Requirements

2.1. System Overview

Watchbird™ will be a home monitoring system that is adaptable to conform to the needs of its users. Its "black box" problem analysis is shown in Figure 1.

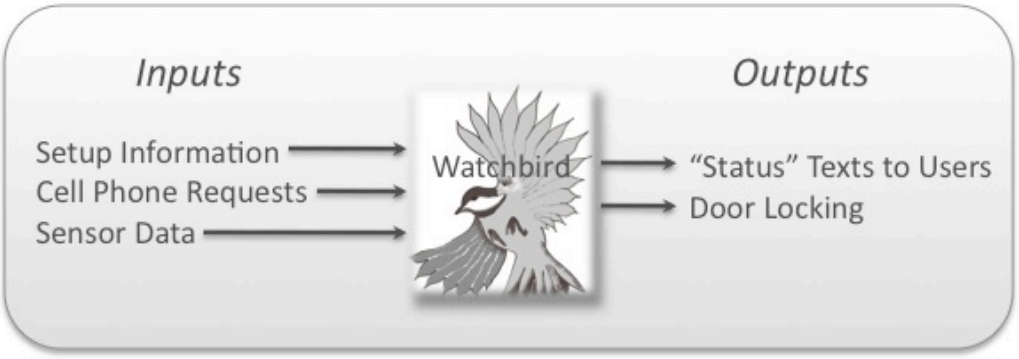

Figure 1: Watchbird™ "Black Box" Analysis

The system takes setup information (the user's cell phone numbers, passwords, sensor names, and settings), sensor information, and cell phone requests, filters them and either sends "status" texts to users or automatically locks a door.

To set up the system, the user must log into the Chickadee Tech server and configure their account. They will provide names for each sensor (i.e. "Front Door", "Kitchen Window", or "Oven"), cell phone numbers they wish to have status updates sent to, passwords for each cell phone number, and settings.

In normal operation, the user will send a text message to the Chickadee Tech server indicating that they would like to make a query. The server then communicates with the user's base station requesting sensor data. The base station then contacts the sensor modules requesting their status. The sensors return their status to the base station, which sends this information back to the server after all of the sensors have checked in. The server then sends a text message back to the user with the status of all of the sensors.

If the user finds their front door unlocked, they can then send another text to the Chickadee Tech server requesting that it be locked. The server then again communicates this request to the base station, and the base station contacts the door lock actuator, which locks the door.

Watchbird™ will also have functionality to remotely unlock the door, in case of unexpected guests or lost keys. Due to time constraints, Chickadee Tech will not implement full security features in the prototype model. The unlocking functionality present in the prototype will be for proof-of-concept purposes, with the option of disabling the feature.

2.2. Block Diagram

The block diagram of the Watchbird™'s components is shown in Figure 2.

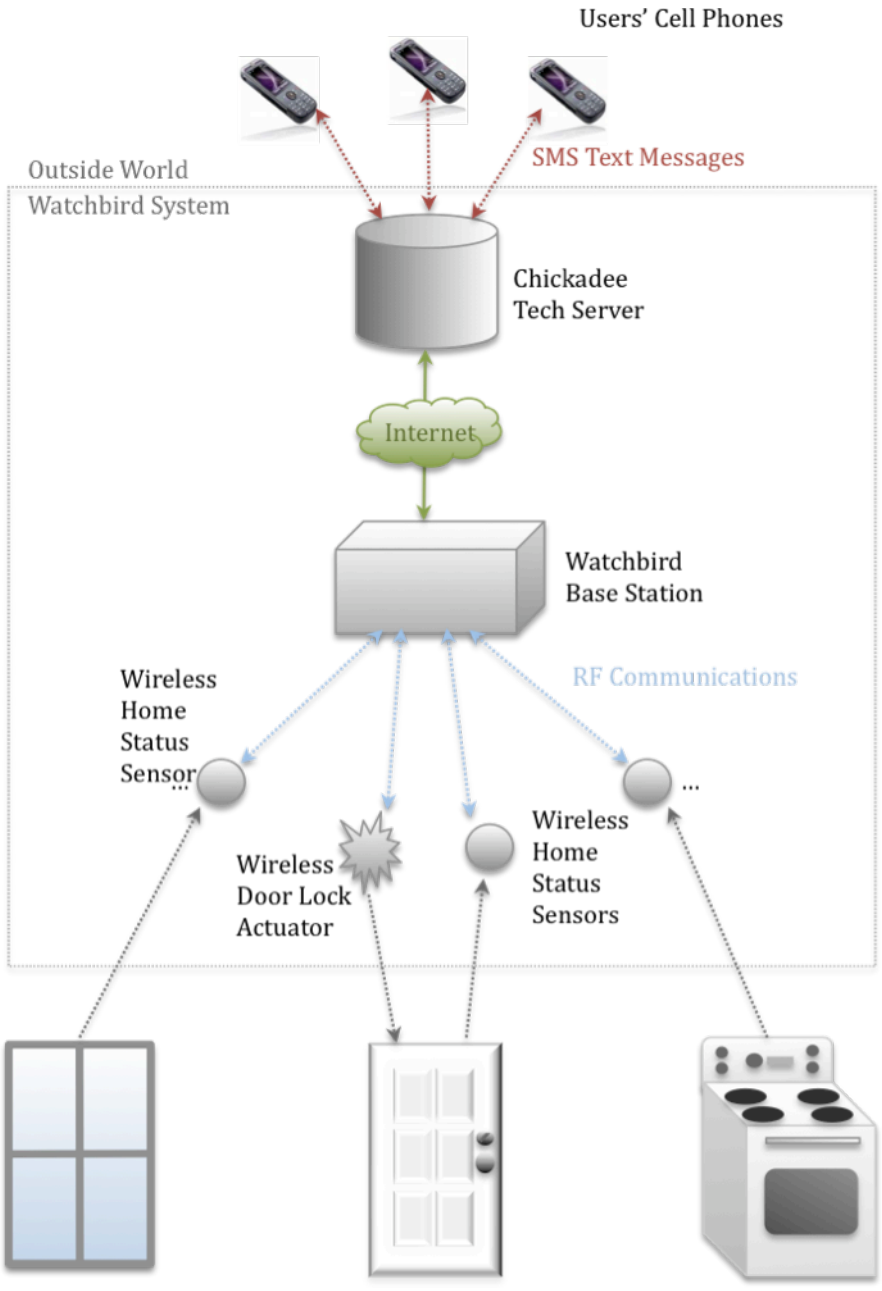

Figure 2: Watchbird™ Block Diagram

The requirements for each of the above components are presented in Section 3.

2.3. Full-System Requirements

2.3.1. General Requirements

[FS-1- II] The system will have no monthly fee from Chickadee Tech.
[FS-2- II] The retail price of the system will be under $500 CAD.
[FS-3- I] The system will be flexible and configurable by the user.

2.3.2. Physical Requirements

[FS-4- I] The system will blend into the home environment.
[FS-5- I] The system will not obstruct the user's home with wires and cables.
[FS-6- I] The system will not physically damage the user's home.
[FS-7- I] The system will have a modern, attractive appearance.
[FS-8- I] The system will be protected from small static shocks and bumps.

2.3.3. Electrical Requirements

[FS-9- I] The components of the system will be powered by either a power adaptor compatible with North American power outlets or readily available batteries.
[FS-10- II] All batteries in the system will last for a minimum of 2 months without replacement.
[FS-11- I] All batteries in the system will be easily replaceable.
[FS-12- II] The system will produce low-battery warnings when necessary.
[FS-13- I] The system will run constantly.
[FS-14- III] The system will have easily accessible testing points for voltage and current measurements.

2.3.4. Environmental Requirements

[FS-15- I] The system will be suitable for indoor, household use.
[FS-16- I] The system will operate normally in temperatures ranging from 10˚C to 40˚C.
[FS-17- I] The system will operate normally in humidity levels ranging from 10% to 80%.
[FS-18- I] The system will operate normally at altitudes ranging from 0m-3000m above sea level.
[FS-19- I] The system will require an internet connection via an Ethernet port.
[FS-20- I] The system will not interfere with other wireless electronics present in the home environment.
[FS-21- I] The system will run quietly and will not produce excess light.

2.3.5. Usability Requirements

[FS-22- I] The system will be user-installable.

[FS-23- I] The system will be user-expandable in that extra sensors and actuators may be purchased and installed by the user as needed.
[FS-24- I] The system will be serviceable by a technician.
[FS-25- I] Each sensor will be identified by a user-chosen name.

2.3.6. Safety Requirements

[FS-26- II] The system will shut off if it reaches an unsafe operating temperature.
[FS-27- II] All electrical and mechanical components of the system will be enclosed and not user-serviceable.
[FS-28- II] The system will be secure, with encrypted data transfer and password protection.
[FS-29- I] Remote unlocking of the door may be disabled for security purposes.
[FS-30- II] The system will perform power-on-diagnostics to ensure that it is in correct operating condition.

2.3.7. Performance Requirements

The timing requirements for worst-case scenarios are presented in Figure 3 and Figure 4, for a query request and a lock request respectively. Both of these diagrams assume a maximum response time of one second per sensor, with one re-try if necessary. The individual timing requirements of each of the components will be presented later in this document.

[FS-31- I] The total time the system takes to process and complete a query will be no more than 31 seconds, with the exception of any delays in the cell phone provider's SMS delivery.
[FS-32- I] The total time the system takes to process and complete a request to lock or unlock the door (as well as query all the sensors) will be no more than 35 seconds, with the exception of any delays in the cell phone provider's SMS delivery.

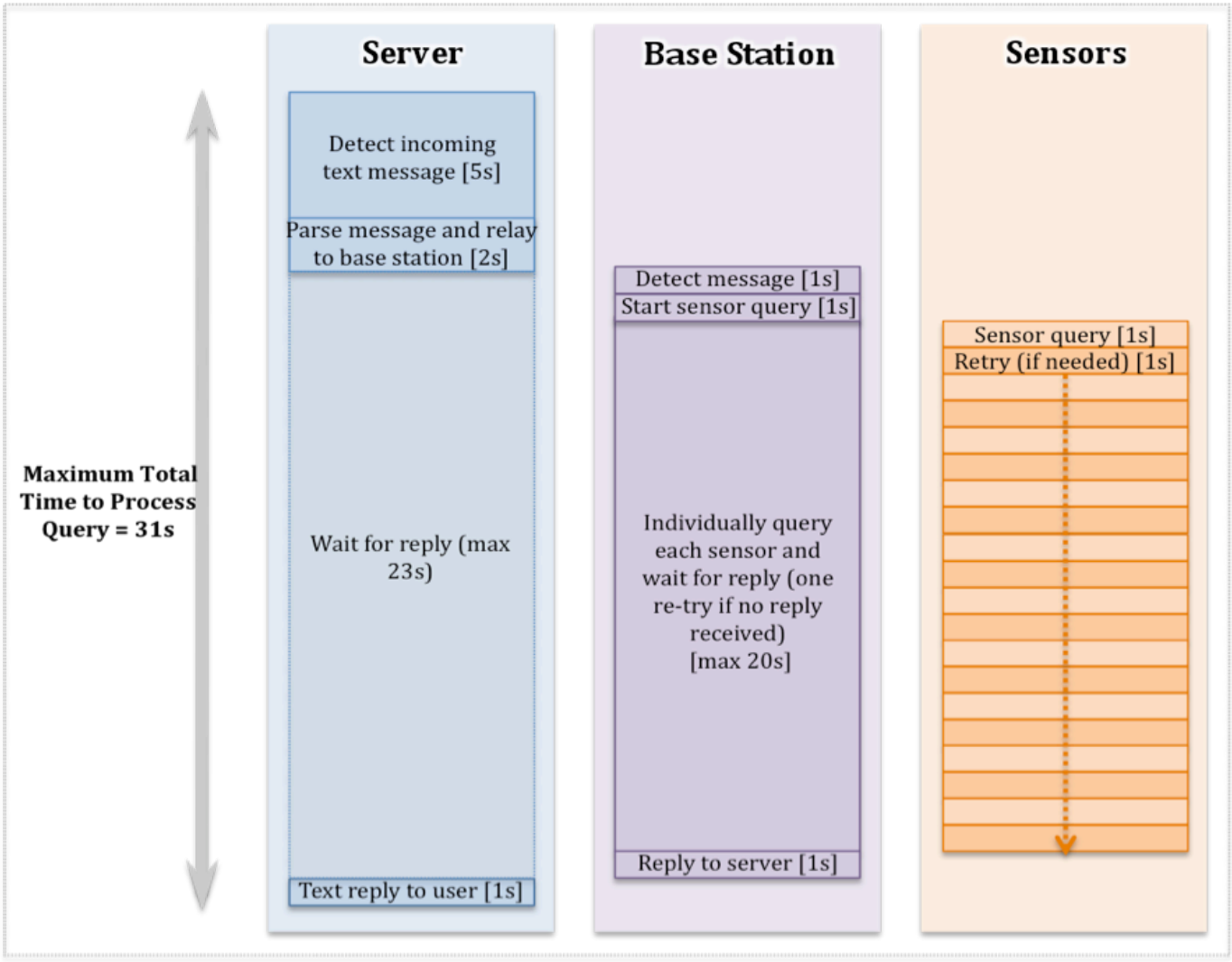

Figure 3: Timing Diagram for Query Request

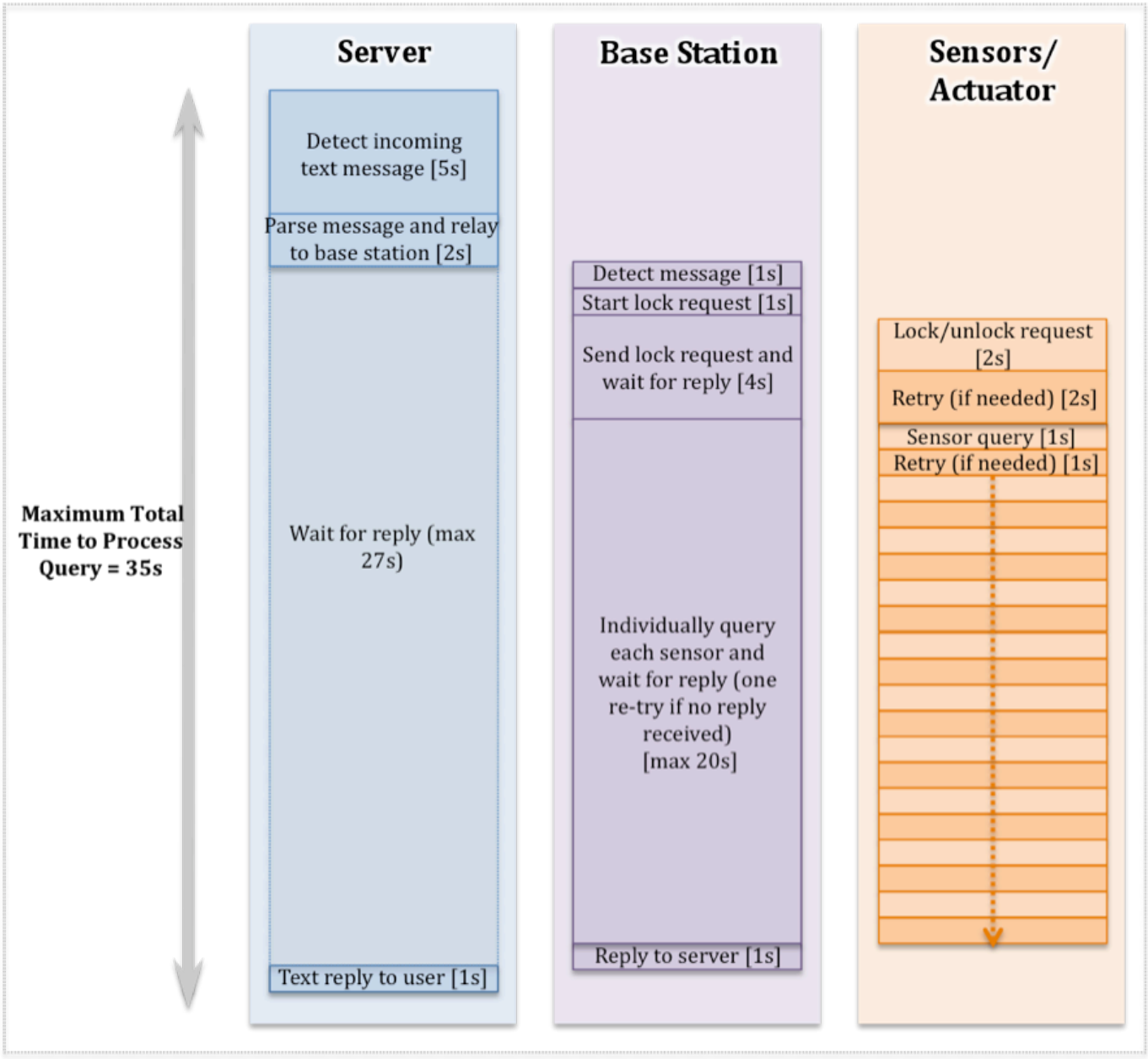

Figure 4: Timing Diagram for Lock/Unlock Request

2.3.8. Reliability and Durability

[FS-33- II] The system will have a mean time between failure of 10 000 hours, running continuously.

[FS-34- II] The system will have a lifespan of at least 3 years of normal use.

3. Requirements for the Individual Components

3.1. Server

Chickadee Tech will run a server to manage communications between remote users and their systems. The server will receive text messages from the user, query the appropriate base station for sensor information, and send a text message back to the user with the results. It will also provide a web interface for adjusting user settings.

For the proof of concept, the server will support a single base station. However, at the production level, it will support many base stations, as depicted in Figure 5.

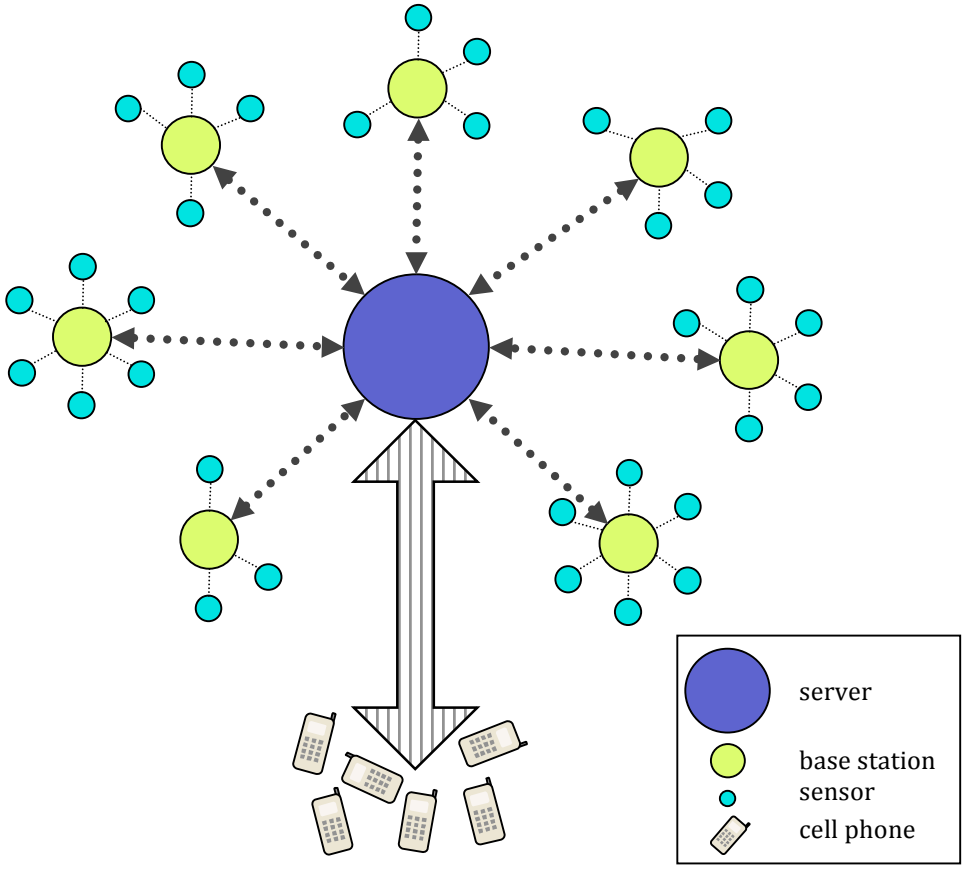

Figure 5: Server's role in coordination

3.1.1. Performance Requirements

[FS-35- I] The server will always be on.
[FS-36- I] The server will check for incoming text messages every 5 seconds or more frequently.

[FS-37- I] The server will parse a text message and query the base station within 2 seconds after receiving the message.
[FS-38- I] The server will send a response text within 1 second after the base station responds.
[FS-39- I] The server will inform the user if the base station does not respond within a maximum time defined by the number of sensors in the system (the limit of which will be 31 seconds for a query, and 35 seconds for a lock/unlock request in a 10 sensor system).
[FS-40- II] The server will run on a dedicated set of machines at Chickadee Tech's headquarters.
[FS-41- II] The server will be capable of handling up to 10 000 base stations.
[FS-42- II] The server will be linked to a dedicated domain name.
[FS-43- II] The server will maintain its own system for SMS text communication with cell phones.
[FS-44- III] The server will facilitate SMS text communication with cell phones using an email and Twitter based system.
[FS-45- III] The server's IP address will remain constant during each test session.

3.1.2. Safety Requirements

[FS-46- II] The server will store user data in a secure manner.
[FS-47- II] The server's database will be backed up daily.

3.2. Base Station

The base station will be the central unit of the customer's system. It will receive queries from the server, query the status of sensor units, and respond appropriately. It will also send commands to the door lock actuator when instructed to do so by the server. Additionally, the production model base station will have a keypad and display for user configuration. The prototype's LCD display will be used only to indicate the status of the base station and sensors.

3.2.1. Physical Requirements

[FS-48- I] The base station will be unobtrusive.
[FS-49- II] The base station casing will not exceed 20 cm x 20 cm x 10 cm.

3.2.2. Electrical Requirements

[FS-50- I] The base station will be compatible with North American power outlets.
[FS-51- I] The base station will connect to a standard Ethernet cable.

3.2.3. Performance Requirements

[FS-52- I] The base station will support up to 10 sensors and actuators.
[FS-53- I] The base station will detect messages from the server within 1 second.

[FS-54- I] The base station will query the sensors or send a lock/unlock request to the actuator within 1 second after receiving a message from the server.
[FS-55- I] The base station will respond to the server within 1 second after receiving replies from the sensors.
[FS-56- I] The base station will re-send the query or request if any sensor does not respond within 1 second, or if the lock actuator does not respond within 2 seconds.
[FS-57- I] The base station will inform the server if any sensor or actuator is unresponsive after 2 attempts at communication.
[FS-58- I] The base station will use the appropriate sensor to confirm door locking/unlocking.

3.3. RF Transceivers

Each sensor will communicate with the base station via wireless signals. The transceiver module connected to each sensor will send a signal indicating the sensor status only when it receives a query from the base station.

3.3.1. Physical Requirements

[FS-59- I] The RF transceivers will be a maximum size of 5 cm x 5 cm x 1 cm.
[FS-60- II] The RF transceivers will be properly shielded from electromagnetic interference.
[FS-61- I] The RF transceivers will be easy to attach in a secure manner.
[FS-62- I] The RF transceivers will be easy to detach without damage to the home.

3.3.2. Electrical Requirements

[FS-63- I] The RF transceivers will consume no more than 40 mW when not communicating.
[FS-64- I] The RF transceivers will consume no more than 80 mW while communicating.
[FS-65- II] The RF transceivers will deliver a warning to the base station if the battery is low.

3.3.3. Standards

[FS-66- II] The RF transceivers will conform to Part 15, Section 231 of the Code of Federal Regulation, Title 47, as issued by the Federal Communications Commission [3].
[FS-67- I] The RF transceivers will function normally in a household with other wireless communication systems (such as cordless phones, wireless internet, and video game controllers).
[FS-68- I] The RF transceivers will not interfere with other household wireless communications.

3.3.4. Performance Requirements

[FS-69- I] The RF transceivers will receive and transmit data over an indoor range of 100 ft.
[FS-70- I] The RF transceivers will respond to prompts from the base station requesting data.

[FS-71- I] The RF transceivers will read analog data from the position sensor.

3.4. Sensor Modules

Each sensor module will connect to the transceiver with two wires, and each sensor will be fitted with various clips to clamp on to locks and switches.

3.4.1. Physical Requirements

[FS-72- I] The sensor module will have a maximum size of 2 cm x 2 cm x 2 cm.
[FS-73- I] The sensors will be easy to attach in a secure manner.
[FS-74- I] The sensors will be easy to detach without damage to the home.

3.4.2. Electrical Requirements

[FS-75- I] The sensor module will consume no more than 80 mW while operating.

3.4.3. Performance Requirements

[FS-76- I] The sensor module will produce a bi-state analog output.

3.5. Lock and Lock Actuator

For users who wish to lock and unlock their door in addition to simply checking its status, a door lock with an actuator will be required.

A visual overview of the connections required between components is presented in Figure 6.

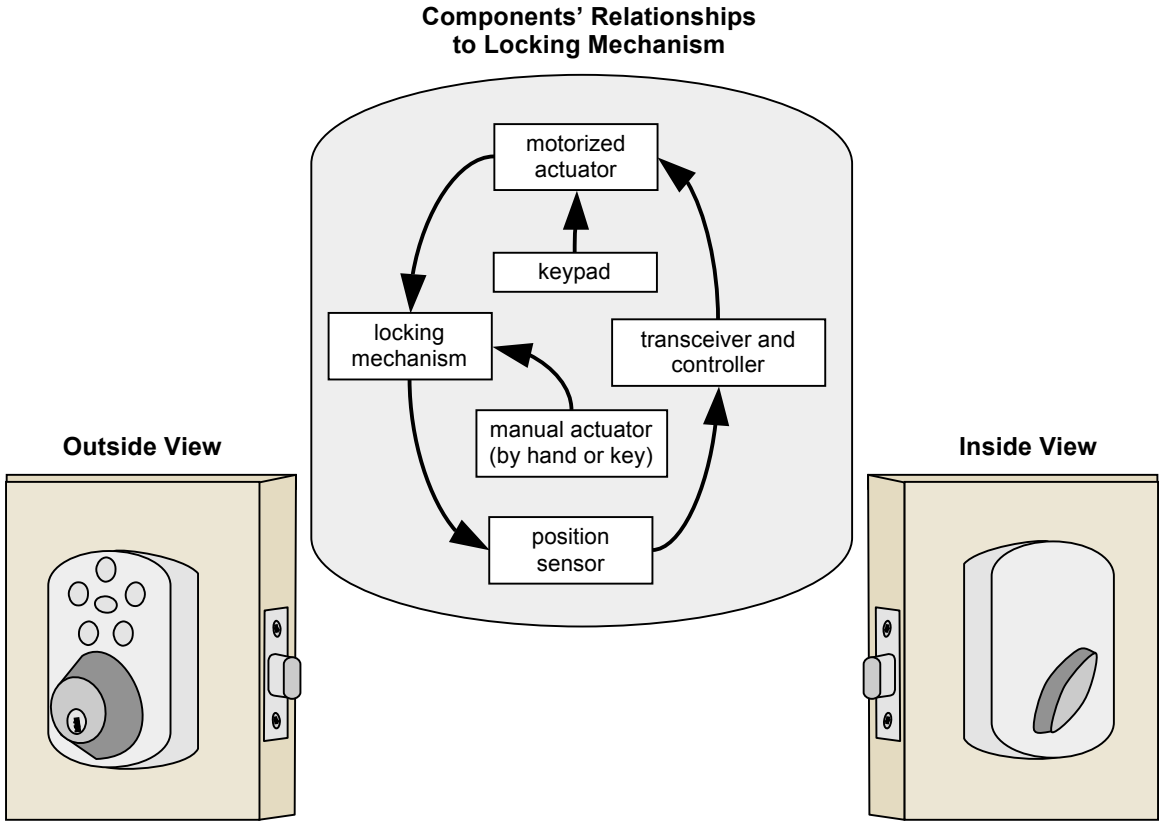

Figure 6: Visual overview of lock requirements

3.5.1. Physical Requirements

[FS-77- I] The lock/actuator combination will install into an existing lock opening in a door.
[FS-78- I] The lock will provide security comparable to a standard deadbolt.
[FS-79- I] The lock will provide a location for a proximity sensor.
[FS-80- I] The lock/actuator combination will have maximum dimensions 15 cm x 8 cm x 10 cm, where the depth refers to the combined dimension on either side of the door.

3.5.2. Mechanical Requirements

[FS-81- I] The lock will allow manual locking and unlocking from inside using a conventional lever.
[FS-82- I] The lock will allow manual locking and unlocking from outside using a key.
[FS-83- I] The actuator will allow motorized locking and unlocking from outside using a keypad.
[FS-84- I] The actuator will allow remote locking and unlocking capabilities via an RF transceiver.

3.5.3. Safety Requirements

[FS-85- I] The actuator will protect the bolt and motor from damage if the motor is actuated while the bolt's motion is impeded.

3.6. User Interface for Setup

Each Watchird™ base station will require configuration through a user interface (UI). It will require the user to enter information needed for the base station and cell phone to send messages to each other.

3.6.1. General Requirements

[FS-86- I] The UI will be easy to understand and use.
[FS-87- II] The UI will be accessible through the company website.
[FS-88- II] The UI will offer registration for new users and a login menu for returning users.
[FS-89- II] The UI will transmit user data in a secure manner to the company server.

3.6.2. User Registration Menu Requirements

[FS-90- II] The UI will request a 16 ASCII character registration key included in the Watchbird™ installation package.
[FS-91- II] The UI will record a user name and password for login information.
[FS-92- II] The UI will accept user names of up to 10 ASCII characters.
[FS-93- II] The UI will accept passwords with between 7 and 20 ASCII characters.
[FS-94- II] The UI will collect up to 5 cell phone numbers for Watchbird™ access.
[FS-95- II] The UI will list available sensor modules which the user can name.
[FS-96- II] The UI will accept sensor names of up to 20 ASCII characters in length.
[FS-97- II] The UI will list available lock actuators which the user can name.
[FS-98- II] The UI will accept lock names of up to 20 ASCII characters in length.

3.6.3. User Settings Menu Requirements

[FS-99- I] The UI will accept requests from the user to add new sensors or lock actuators.
[FS-100-I] The UI will list available sensor modules which the user can rename.
[FS-101-I] The UI will accept sensor names of up to 20 ASCII characters in length.
[FS-102-I] The UI will list available lock actuators which the user can rename.
[FS-103-I] The UI will accept lock names of up to 20 ASCII characters in length.
[FS-104-I] The UI will provide an option to change the user account password.
[FS-105-II] The UI will list 5 cell phone number fields which the user can edit.

3.7. Documentation

3.7.1. Usability Requirements

[FS-106-I] The user manual will be easy to understand.
[FS-107-I] The user manual will provide step-by-step instructions for all common tasks.
[FS-108-I] The user manual will provide a troubleshooting guide.
[FS-109-I] The user manual will provide contact information for technical support.

4. Test Plan

Extensive testing will be done on the system to ensure it meets the specifications outlined in this document. Most of this testing will be done on the various components separately, after which some additional testing will be done on the combined system. The specific test processes will be detailed in the design specifications, but the general methodologies are outlined below.

4.1. Physical and Electrical Requirements

These tests will include requirements such as physical size or power usage. They will initially be checked in the design, through measurement, calculation and/or simulation. They will then be verified again by measuring the prototype in as many states as are applicable.

4.2. Performance and Usability Requirements

Tests will be conducted to evaluate requirements such as response time and user interface details. These will be checked in design where possible, and verified at the prototype stage by running it through typical usage scenarios. Testers will include people unaffiliated with Chickadee Tech to ensure that the system is easily usable by someone not familiar with the system design. Additionally, extreme values and cases will be tested when applicable to verify the full range of things such as user name length.

4.3. Safety Requirements

The prototype will be run through many typical usage scenarios or extreme cases to ensure that all safety specifications are met.

4.4. Standards

In both the design and prototype stages, the system will be tested carefully to ensure that it meets or exceeds all standards specified.

In addition to this testing at the design and prototype levels, another full round of testing will be done at the production level, to again verify all requirements are met.

5. Conclusion

In this document, Chickadee Tech has detailed the functional specifications for the Watchbird™ remotely accessible home monitoring system. In summary, the document has outlined what is required to make the system usable, reliable, and secure for the broad target market of homeowners.

All members of the company will use these specifications to guide their design choices in for the prototype system. By April of 2009, Chickadee Tech plans to have a functioning system incorporating all the specifications critical for the proof of concept level.

6. References

[1] Newcastle Building Society, "Securing your home is common sense but one in ten fails to lock the door", *Newcastle Building Society*, June 26, 2008. [Online]. Available: http://www.newcastle.co.uk/content/docs/2008-press/26-06-2008.pdf,. [Accessed: January 17, 2009].

[2]M.M. Consulting & Services Inc., "Statistics Alarm & Security," *Alarms B.C.*, Apr. 07, 2008 [Online]. Available: http://alarmsbc.com/statist.htm. [Accessed: January 17, 2009].

[3] Federal Communications Commission – Wireless Telecommunications Bureau, "Code of Federal Regulations, Title 47, Part 15, Section 231," *FCC: Wireless Telecommunications Bureau: Rules and Regulations*, [Online]. Available: http://edocket.access.gpo.gov/cfr_2007/octqtr/pdf/47cfr15.231.pdf. [Accessed: February 14, 2009].