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RUSH

January 21, 2008

Dr. Patrick Leung
School of Engineering Science
Simon Fraser University
Burnaby, BC
V5A 1S6

Re: ENSC 440 Proposal for a Helmet-Embedded Communications System

Dear Dr. Leung,

Driven by interest and experience, our ENSC 440 team is firmly dedicated to design and implement a helmet-embedded two-way radio with wireless control and GPS logging capability. Our innovative system will provide a convenient solution to the communication needs of snow-sports enthusiasts. We have outlined our project in the attached document, *Proposal for a Helmet-Embedded Communications System*.

Included in our proposal is an outline of our product, sources of information, a description of our budget and funding and information on team organization and the experience of our management. A brief analysis of competitive products and a plan for project completion are also included.

Ensuring the success of our proposal is a team of five enthusiastic and talented individuals from the School of Engineering Science: Mathew Bond, Daniel Hessels, Robert Hueber, Darren Jang, and Rob Tyson. Please feel welcome to contact us by phone at 604-783-9650 or email at ensc440-rush@sfu.ca if you have any questions regarding this proposal.

Sincerely,

Mathew Bond, CEO RUSH

Enclosure: Proposal for a Helmet-Embedded Communications System

cc: Mr. Steve Whitmore, Mr. Brad Oldham, Mr. Jason Lee

Raven

Proposal for a Helmet-Embedded Communications System

Management Team:	Mathew Bond Daniel Hessels Robert Hueber Darren Jang Rob Tyson
Contact:	Mathew Bond ensc440-rush@sfu.ca
Submitted to:	Dr. Patrick Leung Mr. Steve Whitmore Mr. Brad Oldham Mr. Jason Lee

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Executive Summary

Today's unstoppable trend in personal communications will continue to increase the quality and convenience of the connectivity people enjoy. Consumer demand has proven insatiable for the technologies that enable them to connect with one another. This is especially so when breakthrough technologies offer new or more convenient ways for people to communicate.

An obvious example of this is the widespread popularity the Family Radio Service (FRS) personal handheld radios that have deeply penetrated the communications market. Their use at ski resorts has become especially commonplace due to the nature of both the activity and terrain. The reassurance and convenience they provide family or friends who are out of sight from one another are now an expected practicality for many. Thus far, these two-way radios have only suffered from the need to reach into ones pocket in order to use them.

To address this inconvenience for on-mountain users, the RUSH helmet-embedded communications system features wireless push-to-talk (PTT) functionality. This approach integrates a lightweight FRS radio into a stylish snow-sports helmet, which is activated by a miniature clip-on wireless PTT button easily accessed with gloved hands. The RUSH helmet-embedded solution offers its wearers a sophisticated communication system that revolutionizes the operation of the personal two-way radio, while also incorporating a GPS receiver and an auxiliary audio input jack for mp3 players. This innovative RUSH solution features an efficient microcontroller that seamlessly orchestrates GPS data logging and position broadcasting features in unison with the radio and music-playing functionality.

RUSH breaks new ground with their RUSH Fox and RUSH Raven, women's and men's respectively, series of high performance specialty helmets. No existing product claims to offer a comparable level of convenience or functionality.

The RUSH team is uniquely positioned to seize this exciting opportunity and will demonstrate a professional-quality functional prototype of this helmet-embedded communications system by April 4, 2008. Its members will leverage their combined expertise to research, design, prototype, test, and fully document the proposed solution. They have implemented strategies to ensure their project will conclude on time and within the proposed budget of $572.

Table of Contents

Introduction

Skiing and snowboarding are very popular activities; over 2.5 million people in Canada alone take part in these activities every year [1]. Safety has emerged as an important issue for this market, and consequently, helmet use has now become the norm at major resorts as the numbers of those without helmets continues to dwindle. A wide array of helmets is already on the market, many of which include electronics such as Bluetooth and retail prices exceeding $300. There is clearly an existing demand for feature-rich, communication enabling helmets that incorporate onboard electronics.

Various communication systems, such as cellphones and handheld two-way radios are frequently used by skiers and snowboards to conveniently coordinate group activities. Handheld GPS units are also often used by those wishing to find their way or track their progress in a variety of outdoor activities. While small, these devices can still be cumbersome or impossible to use with gloved hands or while in motion down a snowy slope.

RUSH aims to solve this problem through the creation of innovative integrated audio products. We will create a snow-sports helmet which will facilitate convenient, crystal-clear communications between users and provide detailed data about their performance or position on the slopes. The RUSH Raven and RUSH Fox helmets will offer users helmet-embedded communications with wireless control along with an integrated GPS receiver for performance tracking. Together these products will form a unique and convenient offering in the field of outdoor personal communications.

The RUSH Raven is a unique product that will provide several useful and previously unavailable features to snow-sports enthusiast. While it requires the integration of many separate components, the use of off-the-shelf components will allow for a fully functional prototype helmet to be built within the allotted time. The details of the proposed implementation of the RUSH Raven follow.

System Overview

The value of the RUSH: Raven and RUSH: Fox helmets is that they both offer consumers the safety of a snow-sports helmet and the practicalities of a full-featured outdoors communication system – all in one product! The conceptual overview in Figure 1 below illustrates that, in their most basic form, the Raven and Fox combine a traditional snow-sports helmet, an FRS radio system, and a GPS receiver into a singular helmet-embedded communication system.

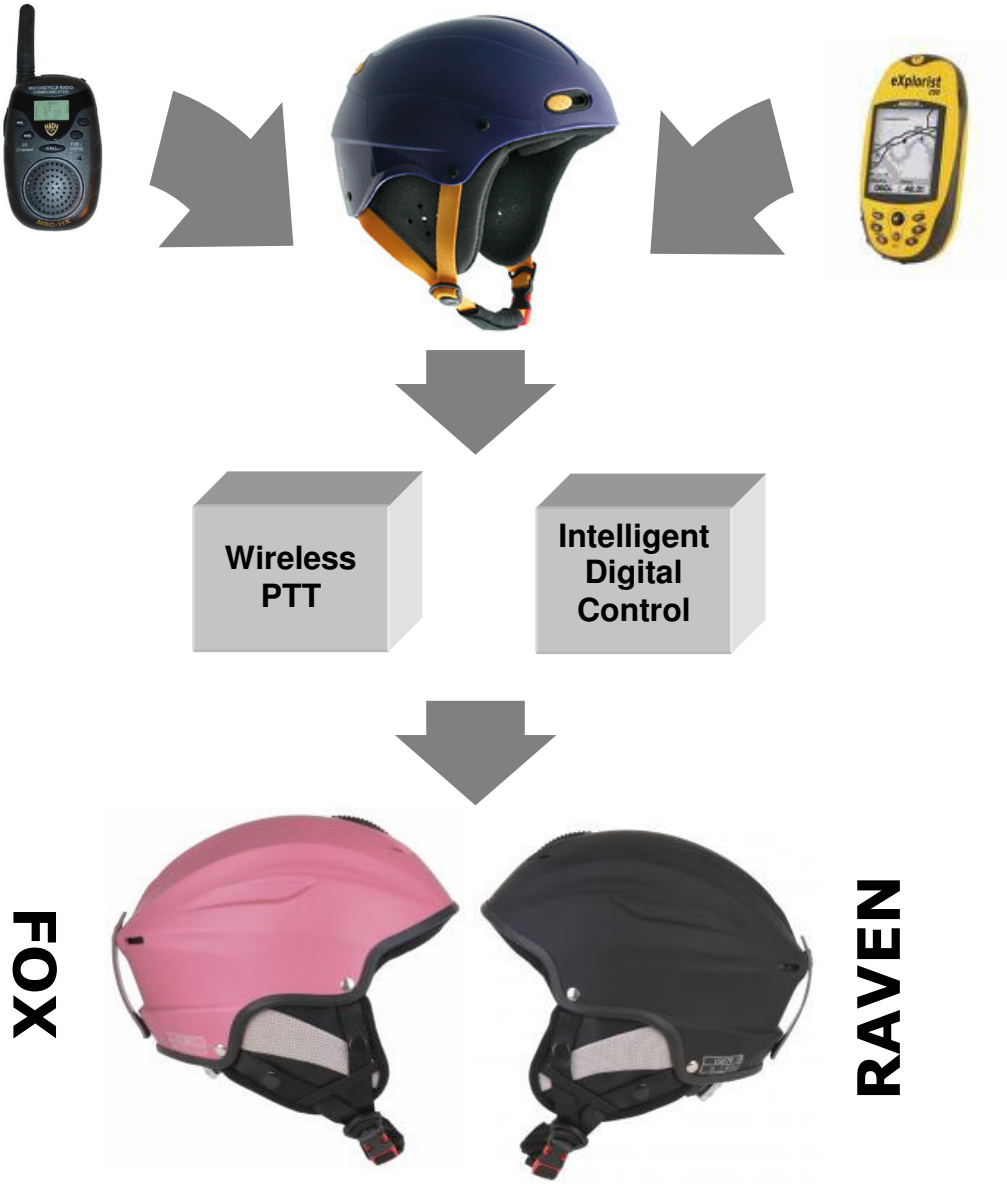


Figure 1: Conceptual Overview [2][3][4][5][6]

Value is further added to the Raven and Fox products through the inclusion of an external wireless Push-To-Talk (PTT) controller. This controller enhances product usability by giving the user an easy means to control the helmet's communication features without hindering their balance. The wireless PTT controller may be attached anywhere on a users outerwear, yet will also be small enough for use inside ones glove.

Competitive Analysis

With the enormous growth in the use of personal electronic devices such as cell phones, PDA's and iPOD's, there is a push to create a single electronic device that conveniently integrates all the functions they provide. Established companies have made numerous attempts at addressing this need, but none are particularly well suited for snow-sports.

Handheld Two-Way Radios

Handheld two-way radios are currently the most popular method of communication for snow-sport enthusiasts. High end models such as the Garmin Rino 530 not only have the functionality of a two-way radio, but come with an extensive list of features included voice activation, text messaging, and a full featured GPS system including colour display [7]. These features come with a significant price tag, as the Rino 530 comes in at over $500 US. For snow-sport enthusiasts wearing gloves or mittens in sub-zero conditions, the inconvenience of accessing and controlling handheld units limits their functionality.

"Walkie-Talkie" Helmet Packages

In response to increasing demand by customers, manufacturers of handheld radios have started to produce headset accessory packages for individuals that already own a two-way radio. These packages are particularly favoured by motorcycle enthusiasts. One such unit is the Midland AVP-H2 which includes headphones that attach inside a helmet, a boom microphone, and a wireless push-to-talk (PTT) button that can attach to the motorcycle's handlebar [8]. This particular unit can be bought for around $50 US. For snow-sports enthusiasts who require a high level of mobility, the requirement of a wired connection between all three of these components and their existing handheld radio is a serious drawback.

Bluetooth Audio Helmets

Snow-sports helmet manufacturers have also caught on to the integration trend. Giro, an international helmet producer, has recently come out with their TuneUps wireless speaker kit. This kit is integrated with a number of their helmets, and allows users to connect wirelessly via Bluetooth to a cell phone or iPOD [9]. While an important step in wireless helmet communications, these products do not provide the embedded two-way radio capability that is unique to the RUSH Raven.

Proposed Solution

In designing our proposed solution, we desire to minimize the overall complexity of the design while creating sufficient flexibility and expandability to allow for the addition of new features in future iterations. Most of the electronics are contained within the helmet, which will also contain the battery and antennas for the FRS radio and GPS receiver. The overall layout of the system can be seen below in Figure 2.

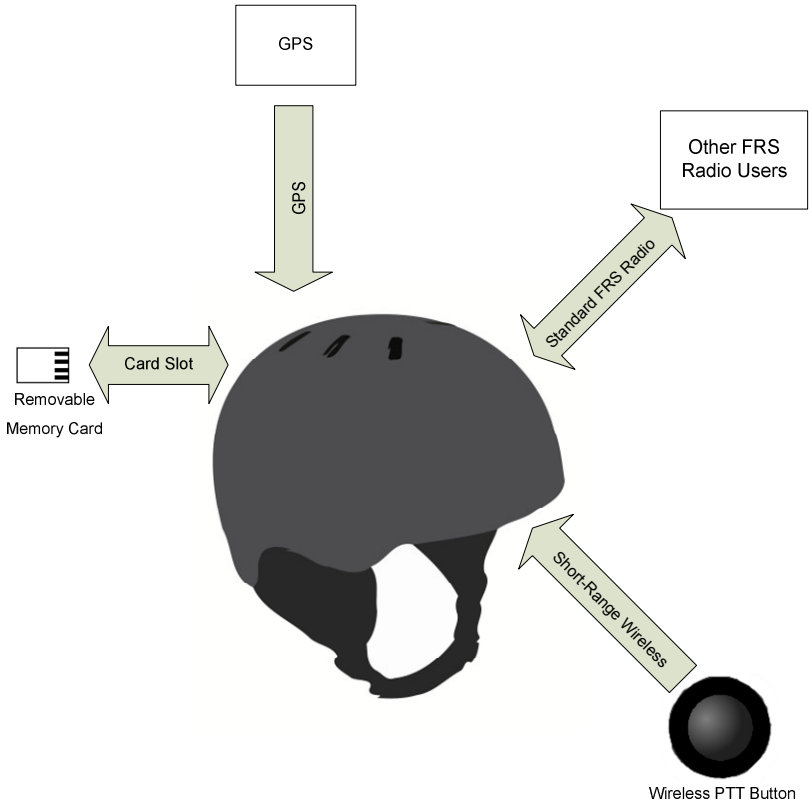


Figure 2: Overall Layout of the System [10]

The primary feature of the helmet, the FRS radio, is controlled by an external wireless button. The embedded FRS radio will receive low-power FM signals from the wireless PTT button and activate the radio's transmitter when the button is pressed. Additionally, several manual controls for controlling the channel and volume, as well as a stereo input jack for listening to music via the speakers will be integrated into the helmet. The FRS radio will be a standard implementation that should allow users of the helmet to communicate with any other FRS radio user provided that they are on the same channel.

The second feature of the helmet will be its GPS receiver. The GPS receiver built into the helmet will continuously log position information while powered-on and write it to a removable memory card. After finishing a day of skiing or snowboarding, users of the helmet can connect the card to their computer and download the data into a program which will display their route and show statistics on speed and distance.

The subsystems operating within the helmet can be seen below in Figure 3.

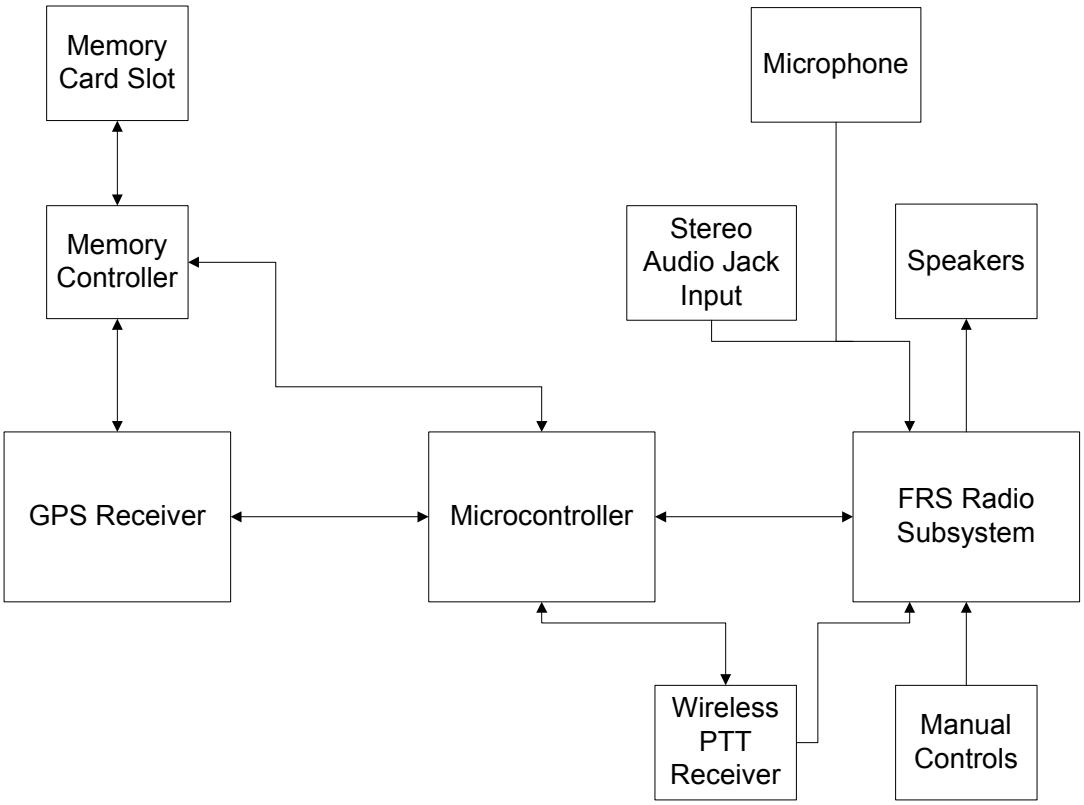


Figure 3: Block Diagram of the Helmet Electronics

The design is centered around a microcontroller, which will control the operation of both the GPS receiver and the FRS radio. However, since the primary function of the microcontroller is to control the storage of GPS data, a provision has been made to separate control of the FRS radio/PTT system from the GPS/microcontroller system should the design need further simplification.

There are also several options for expanding the functionality of the design for possible future product revisions. One option would be to send GPS coordinate data over the FRS radio channel and display it, so that users of the helmet could locate each other. Another would involve the addition of an audio codec chip to allow for music to be played back directly from the memory card. Lastly, the PTT button could be redesigned to enable the wireless transport of stereo audio, which would allow users to easily listen to discrete music devices without needing to connect them to the helmet directly. These and other avenues of expansion make this design highly flexible and well suited for the development of a full suite of integrated audio products.

Sources of Information

There are many possible sources of information for our product development, including several individuals within the Engineering Science community. Dr. Patrick Leung will help provide general guidance on the project as well as specific expertise with embedded systems programming, while Dr. Shawn Stapleton and Dr. Nima Mahanfa may be consulted on issues concerning the selection and integration of RF components. Other members of the ENSC faculty may also be sought out if specific expertise in other areas is required.

In addition to the expertise provided by the faculty, we will be conducting significant amounts of research on the internet. Since many aspects of the project will involve off-the-shelf hardware, data sheets and reference implementations will provide valuable information on the capabilities and implementation details of various component options.

Finally, Daniel's work with Novax Industries, which has considerable experience in the integration of GPS systems, has provided him with valuable industry contacts. These sources of information, together with our previous academic experience, should provide us with all the information we require to complete the project successfully.

Financial Summary

The specific components we intend to design and build our prototype with have not been finalized, hence Table 1 outlines the anticipated costs of parts. This means that extra costs for taxes or shipping and handling are largely unknown; these will thus be estimated at 15% of the total cost of the equipment. The only expenditure to date is for the used FRS radios which were purchased at the price shown.

Table 1: Tentative Budget [11]

Equipment	Estimated Cost
GPS Evaluation Kit	$200.00
SD Flash memory card	$4.79
Flash memory dock	$5.20
Microchip microcontroller programmer	$130.00
Snow sport helmet	$30.00
Speakers	$11.99
Linx chipset	$15.40
FRS Radios	$20.00
Miscellaneous	$40.00
Subtotal	**$457.38**
Taxes and S&H (15%)	$68.61
Contingency (10%)	$45.74
Total	**$571.73**

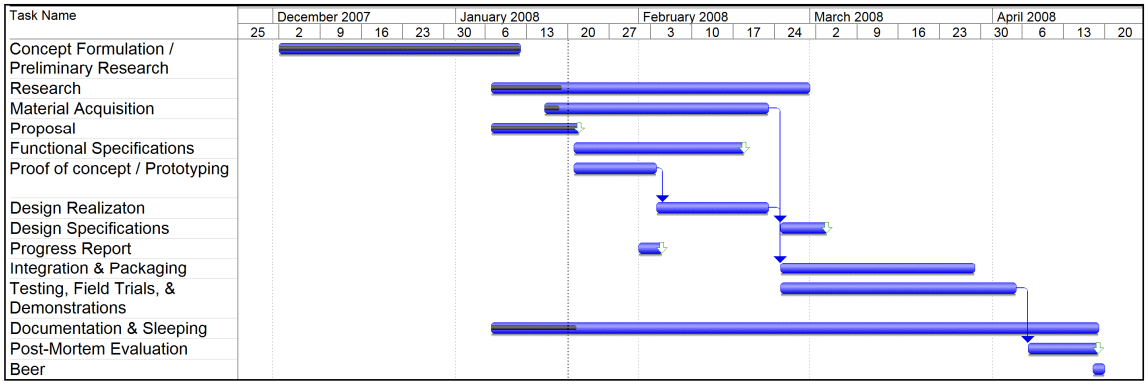
Note that the miscellaneous item is distinct from the contingency item. The miscellaneous item includes materials like nuts, screws, tape, or other hardware, while the contingency is an amount set aside for issues such as underestimates of component costs or costs of damaged component replacement.

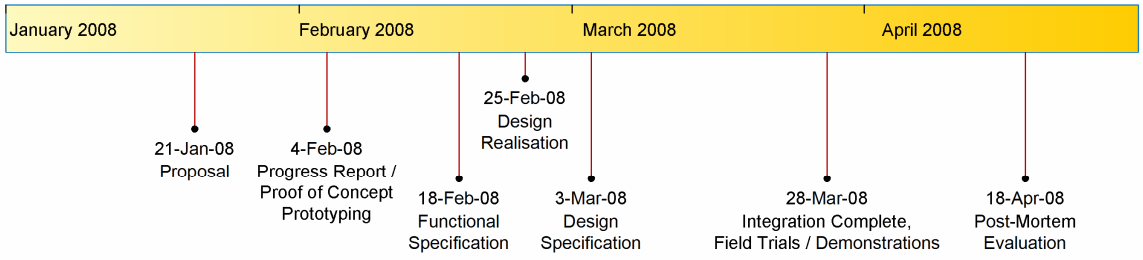
Typical sources of funding include applications to the Engineering Science Student Endowment Fund and the Wighton Development Fund. In addition to the $50 per project for components that is provided by the school, an application to the ESSEF is in progress to apply for funding under the “Class” category. RUSH is also considering applying to the Wighton fund despite the lack of a social benefit, since future models could support safety features such as the use of GPS for avalanche recovery.

Because of the entrepreneurial and consumer product nature of this project the team members expect to contribute to funding development from their personal finances. In this spirit each team member has contributed $50.

Beyond monetary support the ESSEF also has accumulated equipment purchased back from projects in the past that are available to student members for loan. This equipment includes microcontroller development kits and programmers, which are some of the more expensive items RUSH will need to purchase. Part of the ongoing application is a request for a list of this equipment so that we can determine if it is usable on this project.

Project Schedule and Deliverables





Company Organization

The RUSH management team is organised based on the network model, whereby individuals of the team are able to exploit efficiencies related to their expertise, while a designated CEO is recognised to ensure team goals remain the priority. This arrangement can be seen below in Figure 4. Since the strengths of each team member allow them to contribute equally, overall execution of the project goals will largely be shared. However each member has also been assigned the task of ensuring a specific aspect of the project requirements are met. This strategy is designed so that the overall project management burden of the exercise is distributed fairly, and to those best suited to accomplish them.

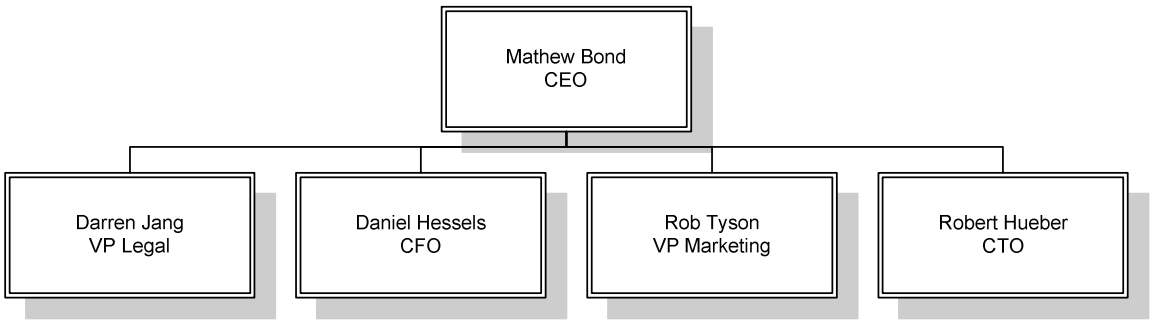


Figure 4: Company Organization

As the Chief Executive Officer, Mathew will have the ultimate responsibility for decisions and planning within the company. He will be ensuring that all necessary business roles are being fulfilled by team members and that the duties of each role are being completed. As manager of communications, he will be tasked with keeping the group's internal communication organized and effective as well as keeping external communications timely and professional.

Darren will be responsible for the legal, safety, reliability and testing aspects of the project. In such a capacity, he will ensure the resulting design maintains compliance with FCC and CRTC requirements for FRS radio operation, and conforms to accepted safety standards. He will also manage the necessary product performance, quality, and reliability testing for a professional quality prototype. He will also share responsibility with Mathew Bond for the overall exterior interface of the design as it relates to packaging (into OEM products) and volume manufacturing processes.

Daniel will be responsible for planning, recording, and monitoring the finances of the project as well as being responsible for the timely purchase of supplies and keeping good records of all transactions. This includes such things as budget creation and maintenance, writing of funding proposals and supplier relations.

Overall management of the technical aspects of the company will be Robert's responsibility. As chief technical officer, he will ensure that the technical progress on the development of specific subsystems will proceed on schedule and meet the appropriate targets. As the manager of research, Robert will also be overseeing the research into components and design options for RUSH.

In his capacity as VP of Business Development, Rob Tyson will overlook marketing aspects of the project as well as the negotiation of strategic corporate alliances. In his second role as Firmware Manager, Rob will be involved with the planning of system architecture as well as firmware development to facilitate flexible, intelligent integration of the product subsystems.

Team Member Profiles

Mathew Bond – Chief Executive Officer and Manager of Communications

Currently in his last semester of the Systems Engineering program at Simon Fraser University, Mathew brings with him several years of experience of successful project management in the academic, business and non-profit sectors. His experience as a self-employed construction site manager has given him a keen understanding of the business, financial, and human resource skills required in a small company. Mathew has the charisma, persuasiveness and drive necessary to motivate and encourage his fellow team members. These characteristics, coupled with his highly valued project management, communication and conflict management skills will ensure that RUSH will deliver an innovative design that arrives on-time and on-budget.

Daniel Hessels - Chief Finance Officer and Manager of Acquisitions

Daniel is a fifth-year Electronics Engineering student at Simon Fraser University. He has gained significant practical experience through co-op work terms at Creo, a division of Kodak, and at NOVAX Industries. His skill set is strongly focused in hardware design and manufacturing, particularly related to RF and analog circuitry. In addition, Daniel is a practiced and efficient programmer who prefers embedded applications that use assembly, C/C++, VHDL, and a variety of application specific scripting languages. His service to the Engineering Science Student Society as VP Finance and Vending Manager, as well as an endowment fund committee member, equips him with a unique set of soft skills important to the success of the RUSH team.

Robert Hueber – Chief Technical Officer and Manager of Research

Robert is an enthusiastic and creative engineer who uses his work and academic experience to create novel design solutions. Currently in his fifth-year of Electronics Engineering, Robert has developed a wide base of essential skills ranging from real-time and embedded system programming in assembly and C to analog circuit design. His experience includes a strong emphasis on digital circuits, with particular experience in logic design and VHDL. This laboratory experience is complemented by co-op work experience that includes development of test automation software and hardware and research into the field of alternative energy. As a member of the RUSH team, Robert will provide an invaluable alternative perspective and critical eye towards feasibility.

Darren Jang – VP of Legal and Customer Support and Operations Manager

Darren holds two diplomas in Electronic Engineering Technology in Telecommunications and Power Systems from the British Columbia Institute of Technology. He also brings with him over four years of professional work experience at Ballard where he helped evaluate the latest engine systems directly for Daimler-Chrysler and Ford. He is currently in his last term of SFU's Systems Engineering undergraduate program that focuses on mechatronics design, modern control systems, and their integration. His diverse experiences and interests allow him to consider challenging problems in a disciplined, systematic approach that result in comprehensive, professional solutions.

Rob Tyson, VP of Business Development and Firmware Manager

Returning from a year in industry working on embedded system design and product development, Rob Tyson is finishing his final semester with the SFU School of Engineering Science. As part of the Technology Brewing Corp development team, Rob's success in product development was attributed to his attention to detail, focus on the user, and his background in ergonomics. During his academic career, Rob's focus has been on modern communication systems and firmware development solutions. His extensive technical experience in industry and academia will allow him to excel in his capacity as Firmware Manager.

Conclusion

The RUSH team has clearly identified an opportunity where it can integrate and enhance existing technologies to achieve the next breakthrough in snow-sports communications. Our innovative helmet-embedded communications system will attract both professional and consumer users with its feature-rich capabilities.

By integrating a FRS radio and GPS receiver into a snow-sports helmet, and providing the wireless PTT functionality, RUSH rides ahead of the competition with unmatched practicality and features. The RUSH project plan clearly and logically describes the development stages and strategies necessary to achieve its goals in a comprehensive and professional manner. The team is highly motivated, experienced, and sufficiently diversified in skill sets to execute the project, and is on-track to meeting its funding goals.

References

[1] Fristoe, N. *The Canadian Model for Growth Overview* . 17 Jan 2008.
http://www.skicanada.org/site/content/pdfs/Model%20for%20Growth%201%20-%20English.pdf

[2] Photo Reference
http://salestores.com/stores/images/images_747/MRC11X.jpg

[3] Photo Reference
http://www.the-gps-place.com/ProductImages/magellan/Magellan-eXplorist-200.jpg

[4] Photo Reference
http://www.blades.com/graphics/product_images/p705481reg.jpg

[5] Photo Reference
http://www.outdoorgear4u.co.uk/images/white%20rock%200708%20212.jpg

[6] Photo Reference
http://www.outdoorgear4u.co.uk/images/white%20rock%200708%20214.jpg

[7] Garmin Ltd. *Garmin Rino 530 Product Description.* 18 Jan 2008.
https://buy.garmin.com/shop/shop.do?pID=283

[8] Midland Radio. *AVP-H2 Product Description.* 18 Jan 2008.
http://www.midlandradio.com/comersus/store/comersus_viewItem.asp?idProduct=4178

[9] SureSource LLC. *Giro Omer Wireless Ski Helmet.* 18 Jan 2008.
http://www.snowshack.com/detail/SNW+G%2D01058+MPW+S

[10] Photo Reference http://www.allianceltd.co.uk

[11] Component Price References:
http://www.digikey.ca
http://www.e-sonic.com