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APPENDIX A. RESUME OF PERSONNEL
I. Introduction/Background

This proposal responds to a Request for Proposal from ViaSat. ViaSat seeks to solve the size restrictions of their mobility antennas by improving the packaging size of their sensor module.

ViaSat produces innovative satellite and other digital communication products that enable fast, secure, and efficient communications to any location. ViaSat is part of the well-known Linkabit Corporation “family-tree” that spawned hundreds of San Diego area telecom startups, including Qualcomm, General Instruments, and Titan. Founded in 1986 by three former M/A-Com Linkabit employees, ViaSat is publicly traded on the Nasdaq Stock Market under the symbol VSAT. ViaSat has also built a line of commercial satellite networking systems for fixed sites and mobility. Products include satellite networking systems and managed network services for enterprise IP applications; gateway and customer-premises equipment for consumer and mobile satellite broadband services; antenna systems; satellite transceivers and other RF equipment; communication chipsets; and communication system design and engineering.

Having instant access to information while on the go has never been more important. ViaSat paves the way with mobile broadband antennas that deliver two-way IP communications in commercial, private, and military aircraft, ground vehicles, and maritime vessels; keeping users productive and informed. The objective of this project is to leverage new technologies to develop a compact sensor module. The newly designed module will increase performance, decrease packaging size, and cut production costs. The purpose of reducing the sensor module size is to work towards integrating it into the antenna itself.
II. Problem Statement

The objective of this project is to develop a compact, low cost sensor module for navigation sensors. This module will be small enough to be embedded in mobile antenna systems and communicate on a shared Control Area Network (CAN) Bus. The target sensor module size is 1.5” x 1.5” x 0.25”. The module will be based around a processor. This processor will be the center of a modular circuit which will allow different sensors to be placed in the package. The circuit will be designed using a Printed Wiring Assembly (PWA) layout which utilizes embedded logic. The module will incorporate a rugged four wire external connector (two wires for CAN, two wires for 5V power). The modular circuit will be encased in a rugged, protective housing. The goal is to run at a low resource utilization frequency; ~100Hz. Figure 1 illustrates a simplified version of the module design.

![Figure 1: Simplified Module Schematic](image_url)
III. Scope of Work

A. Overview

We have broken up our design process into four phases: research, design, review, creation.

First of all there is research. We begin research in pursuit of a microprocessor. There are multiple processors available in today’s market so our group will have to find the one most appropriate for the project. The next priority will be to find a suitable Gyro module. Lastly, we will find modules for an accelerometer, compass, rotary encoder, and GPS. These last few items are of lower priority, as dictated by the project specifications.

Next our team will move onto design. This will mainly include fitting the processor together with the sensor(s) that have been chosen. Plus, we will be taking caution to not exceed the size limit given to us in the problem statement. We shall evaluate various housing options for the sensor module and design them to fit the connected processor and sensor(s) inside of it.

Our tertiary phase is the review process. This is where we will metaphorically take a step back do more research, now that the design is in place. This is to make sure that we do not purchase too many parts or make other unwise decisions. This step is important so that we do not overstep our budget and also so that we save ourselves time.

Lastly, we will begin the creation phase. This will consist of putting the parts together as planned. We will start by prototyping the parts on a breadboard. After that we will move to creating a custom board for the module. It is important to note that the cycle does not end here. Our group recognizes that this is just a part of the whole
design process, and that we will most likely end up going through the other phases multiple times before coming to a final product.

B. Literature Review

Overall, this project is not something that has been done before. The CAN bus protocol was designed for use in the automobile industry, so there has not been very much use elsewhere. We have included relevant projects that were found after a search of the United States Patent and Trademark Office. Also, we put related standards for this project below.

Patents

- Publication No. WO2012121881 A1; Joel Mach\(^1\)

  This patent application serves the purpose of initializing a CAN module with a microcontroller. It mainly deals with general problems of timing, frequency, and error detection.

- Publication No. WO2010057429 A1; Yue Wang\(^2\)

  This patent application deals with monitoring battery voltage and temperature. It uses a CAN bus to communicate to the host controller. The similarity to our project here is in the fact that a temperature sensor is used on a CAN bus.

Standards

- ISO 11898\(^3\)

  The ISO 11898 standard is the main specification of the physical and data connection of the CAN protocol. It is a serial standard and uses two wires. This is the chief standard for the data link layer and physical signaling of the CAN bus and will be

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\(^1\) Joel Mach, *Microcontroller with can bus module and auto speed detect.*

\(^2\) Yue Wang, *Apparatus for monitoring battery voltage and temperature.*

\(^3\) More information and purchasing can be found at [www.iso.org](http://www.iso.org)
important to observe so that our module will be able to communicate with other modules and a host controller.

- **SocketCAN**

The project specifications stated that our team would be using the SocketCAN set of drivers to implement the processor. The idea behind the SocketCAN standard is that it communicates with the CAN bus based on a model of network devices. It was developed by Volkswagen Research.

### C. Alternatives

The main item to consider for this project is the microprocessor. This is because of the fact that certain processors will make the project easier or even possible. For example, if a processor is too big, then it will likely be too large for the size constraints. Furthermore, if a processor it too expensive then it will be a burden on the budget and therefore too costly to use.

The first choice we have is the BeagleBone Black board. This is the processor chosen by the customer, so it automatically seems to be the optimal choice. But we will weigh other options against it to be sure. This board has 92 pins so it will definitely be able to support all sensors necessary. The main problem with the board is that none of the group has any experience with it. This is an issue, because of the fact that programming is a significant part of the project and having experience with the processor would make the coding quicker.

Next is the PIC12C672. This is a cost-effective microprocessor that has been used in CAN bus projects before. The processor’s main strength is the availability of resources online to assist in setting up a CAN bus. However, the processor only has 8

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4 SocketCAN is courtesy of Volkswagen. More information can be found at [www.kernel.org](http://www.kernel.org)
pins. Because of this it will require at least one other chip to act as a transceiver of data. This will drive up the cost, unfortunately.

Last is the Arduino Uno. This board is widely used in today’s industry and is highly compatible with sensors already on the market. Its primary strength is the community behind it and its user-friendly interface. The main issue with this board is that its usefulness runs out with other sensors. The Arduino company makes its own sensors that would be used in the project, but they leave us without alternatives. The limitedness of this board is its chief weakness.

Below is Figure 2, a chart that highlights the different processors we considered and shows a clear choice. There are five different considerations behind the processors: SocketCAN compatibility, Familiarity to Group, Number of Pins, Requested by Customer, and Cost. Each one has a specific weight that determines how important it is to the whole decision. The two most important factors are Cost and Requested by Customer. This is because our group needs to stay within a conservative budget, first of all, and needs to respect the customer’s wishes as well. The other three factors have equal but lesser weights since they are important to the design, but are not as significant in deciding the microprocessor.

<table>
<thead>
<tr>
<th></th>
<th>BeagleBone Black</th>
<th>PIC12C672</th>
<th>Arduino Uno</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SocketCAN compatibility</td>
<td>1.000</td>
<td>0.000</td>
<td>0.000</td>
<td>10</td>
</tr>
<tr>
<td>Familiarity to Group</td>
<td>0.000</td>
<td>0.667</td>
<td>0.333</td>
<td>10</td>
</tr>
<tr>
<td>Number of Pins</td>
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<td>0.063</td>
<td>0.219</td>
<td>10</td>
</tr>
<tr>
<td>Requested by Customer</td>
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<td>0.000</td>
<td>0.000</td>
<td>35</td>
</tr>
<tr>
<td>Cost</td>
<td>0.426</td>
<td>0.257</td>
<td>0.316</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67.114</strong></td>
<td><strong>16.299</strong></td>
<td><strong>16.587</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Figure 2: Decision Chart
D. Proposed Solution

Our solution for this project is to use the BeagleBone Black board to prototype the sensor module. In the last section we explained why it was clearly the best choice. In the design phase of this project we will work on wiring the board with the sensor(s) chosen. Our prototype will be a simple design using a breadboard to piece together all of the separate parts. See section “Prototype Construction” for an example prototype. This board is guaranteed to work since it has so many pins. There is no risk of running out of ways to hook up the sensors to our microprocessor.

Figure 3: Block Diagram
IV. Design Plan

A. Research

The BeagleBone Black was chosen as a development platform that will supplement the SocketCAN. After reviewing multiple platforms, it seems that this board is the most efficient, realistic choice for the project. The BeagleBone is a very powerful platform and supports a wide range of software and hardware modifications. The sensors used will include a Rotary Encoder module, MEMS GYRO module, MEMS compass module, GPS IC module, MEMS accelerometer module, and a CAN bus adapter for the BeagleBone Black. The components are pictured in Figure 4 below.

Figure 4: Module Components
B. Design

The project is broken into two components; software and hardware. Since the project is mostly software, the plan is to get the hardware portion out of the way first, and then grind through the processes involved in programming hardware for the duration of the project. The team has programmed microchips before, and knows how tedious it can be to control hardware via code.

The coding process will require a planning stage, a preliminary coding stage of the first sensor, the MEMS GYRO module, and then the addition of the remaining sensors to satisfy all of the bonus requirements for ViaSAT. In order to configure our devices to the CAN interface; it will use the inherent SocketCAN technology on the board. The plan is to use the BeagleBone Black platform and its components to get a working model of what is required, and then use this model to figure out the components that we actually need to complete the project. The large majority of the components can be scrapped and reduced to a basic model that can then be packaged in the smallest possible way.

The module will use SocketCAN to interface its components to the CAN bus. The CAN bus connects to a transceiver, that will connect to a controller, that will then connect to the SPI's on the I²C bus of the microprocessor. The BeagleBoard is convenient because it has the controller and transceiver pre-connected and interfaced with each other, which is why it was chosen to be used in the preliminary design. The consolidation of the controller/transceiver is an example of how the module will shed weight after the initial design is solidified; as opposed to having the bulky BeagleBoard, it will simply use the controller and transceiver chips, minimizing the final cost, weight, and versatility.
C. Prototype Construction

The prototype is mapped out in Figure 5. The internal processes will utilize the I²C capability inherent in the hardware that we have chosen. We will use this bus to control our sensors, and our TI OMAP Processor will then control all of the logic and timing involved with coordinating the sensors. I²C is a convenient bus that we used on a navigation project in our Microcontrollers course, so we are relatively familiar with the process of working with peripherals. Due to the fact that our board has the SocketCAN technology built in, we will be able to manipulate the code to work with the CAN bus relatively easily. This saves us from having to purchase additional hardware to get our device to work with the CAN protocol. The hardware set up will be simple with only a few connections that need to be made.

![Prototype Schematic](image)

Figure 5: Prototype Schematic
V. Personnel

Carson Drake:

**Position:** Project Manager

**Description:** Carson is responsible for managing the group’s progress and making sure all tasks are completed in a timely manner. Aside from managing the project, Carson also contributes to both the software and hardware development of the project. He has a solid understanding of several programming languages and is proficient at circuit design. Carson is the stern rudder that keeps the team heading straight and setting towards success.

Trent Pulsifer:

**Position:** Hardware Specialist

**Description:** Trent is in charge of determining which hardware is most cost effective, performs best, and best meets the design goals and requirements for the device. Trent will also be in charge of the hardware assembly and housing. Aside from the mechanical aspect, Trent will also assist with software and use his superb organizational and academic skills to propel his team to success. Trent is our workhorse, and he will lead us to the Triple Crown.

James Logan:

**Position:** Software Specialist

**Description:** James Logan is the software manager for the project. He has a minor in computer science and will be working out all things related to programming. With a diverse computer language background he will take charge of the microcontroller and ensure that the sensors’ data is processed. His experience with other serial interfaces will be the key to the group’s success.
VI. Design Schedule

The design schedule for the sensor module is broken down into four main stages, Research, Design, Review, and Creation. Each stage has more specific subtasks that will make completing this project more manageable and will also help measure the exact progress of the project. Figure 6 breaks down the exact schedule of the sensor module project.

Research:

The research phase of this project is composed of several stages. First, there must be a general understanding of what the problem being solved is and what other background information related to the project needs to be investigated. Then after establishing a firm grasp of the relevant concepts, a rough draft proposal will be submitted and then improved further after receiving constructive reviews. The final Proposal draft will then be submitted on Sep. 26th. The findings of the research and proposal will be presented by the team for further review.

Design:

During the design stage of the project, the necessary components and materials will be ordered. Using the BeagleBone Black a prototype will be developed with the primary goal of incorporating the gyroscope module and connecting to the SocketCAN. Once the gyroscope is successfully integrated the secondary objective will be to integrate the GPS, accelerometer/compass, and rotary encoder modules.

Review:

The review stage consists mostly of testing the software. Once the programming used to link the sensors to the CAN Bus is successfully developed, the prototype will be reviewed and evaluated to determine the best way to develop a Printed Wire Assembly layout for the module. A decision will also be made regarding the housing of the module.
Creation:

The creation stage is the most critical stage of the project. In the creation stage the modulated circuit developed in the design and review stages will be developed using PWA. The custom circuit will then be encased into a rugged housing unit and then run through the final system tests. The final production of the module will be presented at the open house poster board session.

![Progress Gantt Chart](image)

*Figure 6: Progress Gantt Chart*
VII. Budget

The budget for this project is very straightforward. For the prototype of the sensor module the following components are needed: BeagleBone Black, Rotary Encoder, Accelerometer/Compass, GPS module, Gyroscope, proto-board, and wiring. Other costs will most likely include shipping and housing development. The associated costs are broken down in Figure 7 below.

<table>
<thead>
<tr>
<th>Approved</th>
<th>Category and Item</th>
<th>Item Notes</th>
<th>Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BeagleBone Black</td>
<td><a href="http://beagleboard.org/Products/BeagleBone%20Black">http://beagleboard.org/Products/BeagleBone%20Black</a></td>
<td>$46</td>
</tr>
<tr>
<td></td>
<td>LSM303</td>
<td>Triple-axis Accelerometer+Magnetometer (Compass) Board</td>
<td>$25</td>
</tr>
<tr>
<td></td>
<td>Adafruit Ultimate GPS Breakout</td>
<td>66 channel w/10 Hz updates - Version 3</td>
<td>$40</td>
</tr>
<tr>
<td></td>
<td>L3GD20 (L3G4200 Upgrade)</td>
<td>Triple-Axis Gyro Breakout Board</td>
<td>$25</td>
</tr>
<tr>
<td></td>
<td>Shipping Costs</td>
<td>Estimated Cost of Shipping</td>
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</tr>
<tr>
<td></td>
<td>Miscellaneous</td>
<td>Unforeseen costs</td>
<td>$44</td>
</tr>
</tbody>
</table>

**Total Estimated Cost:** $222

*Figure 7: Project Budget*
References


Appendices

Appendix A. Resume of Personnel

Carson Drake
carson.drake@gmail.com

Current Address:
810 Avalon Ct. Unit A
San Diego, CA 92109
(661) 343-0760

Permanent Address:
15101 San Domingo Pl.
Bakersfield, CA 93306

Objective: To obtain an internship in electrical/electronics engineering where I can apply my skills in electrical engineering, mathematics, and person-to-person relations to the business world.

Education:
University of San Diego
Major: Electrical Engineering, BS & BA
Minors: Mathematics, Management
GPA: 3.00

Core Classes Completed as of May 2013: Signals and Systems, Logic Systems, Intro to Microcontrollers, Entrepreneurship and New Ventures, Electronics I & II, Material Science I & II, Intro to Engineering (Mechanical, Electrical, Industrial), Intro to Thermal Engineering, Engineering Probability and Statistics, Intro to Circuits, Computer Programming (Java), Calculus III, Differential Equations, Physics I & II, General Chemistry

Technical Skills:
FPGA Logic Design, VHDL, Hardware Simulation, Microsoft Word, Excel, PowerPoint, Visio, MatLab, HTML, CSS, C, C++, Objective C, Active HDL, Competitive Research, Proformas, Information Organizing, Contact Info Research, Circuit and Chip Logic Analysis

Key Projects:
FPGA Board: Designed and implemented, and simulated various combinational and sequential logic designs on an FPGA Xilinx Spartan 3E-250 in Verilog. Input signals were simulated using Chipscope.

Tesla Turbine: Designed and constructed a small-scale steam powered Tesla Turbine that drove a simple AC generator.

PIC18F4550: Assembled and programmed a subsystem utilizing the PIC18F4550 microcontroller using both assembly language and C.

Autopilot System: Mapped out the hardware design and system interface for a nautical autopilot system using a GPS unit and PIC18F4550.

Work Experience:
Bump-Network - A company that provides software for managing member communities
San Diego, CA
Fall-Winter 2012

Associate
- Constructed competitive research reports in the fields of social media, consumer behavior, rewards programs, and membership organizations.
- Over saw share purchases during investment rounds.
- Researched and contacted potential new clients.

ARB INC – A subsidiary of Primoris Services Corporation
San Francisco, CA
Summer 2012

Project Data Manager
- Organized and managed database to track project completion status for thousands of job locations across northern California.
- Worked with Pacific Gas and Electric, sending and receiving location updates, organizing and billing invoices, and helping plan the logistics for the installation of gas meter protection posts.
- Managed flow of job information from PG&E’s inspectors to ARB installation crews.

Ken Small Industries
Bakersfield, CA
Summer 2011

Supervisor Assistant
- Oversaw the mechanical and electrical assembly of various petroleum pump and valve systems.
- Worked in the shipping and receiving department of KS Fabrications.
- Worked with KS Engineering designs while assembling materials for projects.

Additional Information/Awards:
University of San Diego
- Recipient of Presidential Merit Scholarship
- Member of IEEE, 2012
- Mathematical Contest in Modeling 2013

Phi Kappa Theta Fraternity
- Executive Vice President 2013
- Executive Vice President of Social 2012
JAMES LOGAN
9578 Via Pereza - San Diego, CA 92129
Cell: (858) 603-5457 · JamesLogan@sandiego.edu

Education

• University of San Diego - 3.31 GPA – Anticipated Graduation Date: May 2014
  o B.A. and B.S. in Electrical Engineering
  o Minor in Computer Science
  o Minor in Mathematics

• Courses Taken
  Data Structures & Algorithms               Microcomputers           Electronics
  Computer Programming I, II                Probability and Statistics Thermal Sciences

• Recipient of Trustee Scholarship and USD scholarship.

Career

Teledyne Impulse Part-time Employee – San Diego, CA
• Continued data entry during and after implementation of ERP system.
• Worked with individuals to develop quality tests for machined parts.
• Inspected cables with the Final Quality Assessment Department.

Hahn University Center Information Desk Worker – San Diego, CA
• Took calls to cover for the university operator.
• Answered questions in person.
• Worked with University Center Operations.

Federal Work Study, USD Engineering Department – San Diego, CA
• Maintained the computers in various labs.
• Worked with other students to assist the department.
• Helped facilitate the 2010 Engineering Fall and Spring Open House events.

Technical Skills

• Proficient in Microsoft Word, Excel, and Dynamics.
• Experienced in C embedded environments.
• Proficient in Window, Mac OS, and Linux.
• Conversant in Spanish.
• Proficient in Java.

Involvement

• Ambassador’s Club Member                              September 2010 – Present
• InterVarsity Christian Fellowship leader               September 2010 – Present
• Institute of Electrical and Electronics Engineers member September 2012 – Present
Trent Pulsifer

15195 Skyridge Road
Poway, CA 92064
(858) 248-0148
trentpulsifer@sandiego.edu

OBJECTIVE
Long term goals are to establish myself in a corporation as a viable, dependable engineer and co-worker. Short term goals are to achieve a strong command of any delegated tasks, remain focused and assertive, network as much as possible, and remain active and approachable in the workplace.

Clearance
- Department of Defense: Secret Clearance: Adjudicated January 31\textsuperscript{st}, 2013

EDUCATION
University of San Diego Overall GPA: 3.51 Anticipated Graduation- May 2014

Degree: BA/BS in Electrical Engineering with a Minor in Mathematics

Currently enrolled as a full time Electrical Engineering student.

Current Coursework Fall Semester 2013:


Completed relevant course work includes:
- Lab and course experience in circuit design and function, electromagnetic forces, and electric components such as resistors, capacitors, and inductors.

Student Professional Organization
- IEEE
WORK EXPERIENCE

Northrop Grumman Corporation—Palmdale, CA   Summer 2012

Student Technical Liaison Engineering Intern

Worked as a Liaison Engineer for the F-35 Lightning program where my role was to develop tools that the team could use to improve processes in their everyday work environment.

- Used Visual Basic for Applications to develop software tools for the Liaison Group on the F-35 program.
- Wrote VBA code to create programs that would act across different platforms and automate daily tasks.
- Began MRB training and was familiarized with the TAG process from start to finish.

Northrop Grumman Corporation—Redondo Beach, CA   Summer 2011

Student Technical Software Engineering Intern

- Worked extensively with Microsoft Visual Studio C++ and its integrating components.
- Installed various operating systems on virtual machines using VMware.
- Operated across multiple operating systems including RedHat Enterprise Linux 5.6/6.1 and Windows Server 2008.
- Supported HART HITL (Hardware Integration Test Lab) and SITL (Software Integration Test Lab) testing operations.

Northrop Grumman Corporation—Rancho Bernardo, CA   Summer 2010

Student Technical Systems Engineering Intern

Worked as a Systems Engineering intern on the High Altitude Long Endurance (HALE) Systems Engineering Integration Team (SEIT).

- Achieved proficiency in DOORS database. This is an organizational system used to create and manage requirements and their components.
- Achieved proficiency in Rhapsody C++, A supplemental program used to create and organize representative models of structure and processes.
- Achieved proficiency in PARS Database, An organizational program used to manage Program Access Requests or suggested changes in a system or set of systems.