EE SENIOR DESIGN
PROJECT STATEMENT OF WORK
SOFTWARE DEFINED RADIO

TEXAS STATE UNIVERSITY
INGRAM SCHOOL OF ENGINEERING

JAMES BELL
<SAMUEL HUSSEY, ZACHARY SCHNEIDERMAN >

SPONSOR TEXAS STATE UNIVERSITY
601 UNIVERSITY DRIVE
SAN MARCOS, TEXAS, 78666

9/8/2018

Revision History			
Version	**Date**	**Description**	**Author**
0.1	9/12/18	Rough Draft	Team 1.12

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY (SAMUEL HUSSEY)

Our product is a Software-Defined Transceiver that is capable of operating on the North American High Frequency bands. The incoming and outgoing signals will be processed on a microprocessor using digital signal processing techniques rather than hardware to tune the antennae and apply filtering. The primary goals of the build are efficiency, clarity, and repeatability as one of the primary aspects of HAM radio is education. Being a prototype, a secondary goal will be to create a build kit to facilitate learning and ease of entry to the amateur radio community. This means affordable components and refinements where possible for the sake of simplicity and cost.

The first prototype of the finished product will be finished by December 7th, 2018. Moving forward after this date, refinements to the designs will be addressed as well as stretch goals such as a 3D printed casing and Raspberry Pi compatibility alongside the Teensy. With assistance from Dr. William Stapleton, Dr. Semih Aslan, and consultants. The Software Defined Radio Transceiver team will be conducting all aspects of the project on the Texas State University campus including research, assembly, testing and troubleshooting. After all necessary research has been done on all components, schematics and software portion of the design, an acceptable price list will be produced with approval from Dr. Stapleton and Dr. Aslan Lastly, construction and testing will commence with each group member working in conjunction with the others in order to meet deadline requirements and stay within the scope of the project that is further detailed below.

2. BUSINESS NEED (ZACHARY SCHNEIDERMAN)

Texas State University's Electrical Engineering department is sponsoring this project to have a functioning software-defined radio that will not only be a functional amateur radio, but also be useful as a learning tool. Students will be able to use the radio to test various digital signal processing techniques, such as bandpass filtering. Organizations such as BARC and IEEE will also be able to use this radio for training for licensing, as a lecture instruction tool, as well as just for fun as a functioning amateur radio.

3. PRODUCT SCOPE DESCRIPTION (JAMES BELL)

In this project the team will build, test and simplify a high frequency software defined radio prototype. The key features of this radio are as follows,

- It will be able to turn on and off.
- It will be capable of receiving known sources on the north American high frequency band.
- It will have a way to take the received transmissions and convert them to an audio signal
- It will have real time audio.
- It will be capable of transmitting on the north American high frequency band.
- It will be capable of taking in audio and converting it for transmission.
- It will transmit the converted audio with as little latency as possible.

- A clear and simple to access way to alter the frequency transmitting and receiving on in the band specified above.
- It will show the frequency currently tuned in to in a visual way.
- It will be able to run on standard US power.
- Its estimated unit cost should be less than $300.
- The prototype device should resemble the specifications posted as closely as possible
- The single received will be understandable and clear.
- The device will have a volume control for the speaker.
- The device will have the option to select license class
- The device will have an enclosure for safety.
- Optional: Higher Power Amplifier.
- Optional: Have the ability to run on an alternate power source.
- Optional: Be able to run with a Teensy and a raspberry pi.
- Optional: Should have a headphone jack
-

Product Performance:

Features	Performance Targets
Turn on and off	Turns on and off
Receiving known Sources	We will listen to a known broadcast on the high frequency band with this device
Take a radio signal and convert it to an audio signal	Using the Teensy microcontroller, the device will take in Single Sideband Radio signals and convert them to audio signals.
Output audio in real time	Latency of less than 100 milliseconds
Transmitting on North American high frequency band	3MHz to 30MHz
Taking in audio to transmit	It will be able to take in audio from a microphone and convert that signal in the teensy to a Single Sideband radio signal.
Transmitting audio with limited latency	It will do the audio to Single Side band conversion in less than 100 milliseconds
Clear and simple way to alter frequency	Have a dial to select the frequency wanted
Make the frequency tuned in to clearly visible	Have a display showing the current frequency
Run on standard US power	The device can be powered by 110v and 60hertz AC power from any US power outlet
Its estimated unit cost should be less than 300$	The unit will cost less than 300$ to produce
The single received will be understandable and clear	The signal-to-noise ratio of the final device should be 20dB or more
The device will have a volume control method	The device will have a volume control for the audio output
The device will have an enclosure for safety reasons	The User will only be able to access the nobs and control components
Optional: Have the ability to run on an alternate power source	: Run on a 12-volt battery for at least 4 hour of constant transmission

Optional: Be able to run with a Teensy and a raspberry pi	Be able to run with a Teensy and a raspberry pi
Optional: Should have a headphone jack	Will have a 3.5mm standard headphone jack

The intent for this device is to create a simplified build kit for a software defined radio operating on the high frequency band to allow greater access to these devices. This will facilitate education in radio communications, expose to diverse cultures through radio, and ease of access to new methods of radio communications.

4. PROJECT SCOPE DESCRIPTION (ZACHARY SCHNEIDERMAN)

Project Schedule				
Task	**DRI**	**Duration, Wks**	**Start**	**End**
Statement Of Work (Executive Summary)	Samuel Hussey	3	8/31/2018	9/24/2018
Statement Of Work (Business Need)	Zachary Schneiderman	3	8/31/2018	9/24/2018
Statement Of Work (Product Scope Description)	James Bell	3	8/31/2018	9/24/2018
Statement Of Work (Project Scope Description)	Zachary Schneiderman	3	8/31/2018	9/24/2018
Statement Of Work (Sponsor Support Elements)	Samuel Hussey	3	8/31/2018	9/24/2018
Statement Of Work (Approvals Signature)	James Bell	3	8/31/2018	9/24/2018
Watch and take notes on Videos of SDR	All	4	8/31/18	9/24/18
Complete Parts List	Zach	2.5	9/24/18	10/10/18
Setup Arduino Environment and establish understanding the prototype code	James	2.5	9/24/18	10/10/18
Complete Functional Specs	Samuel	2.5	9/24/18	10/10/18

Signed Spec Sheet	James	3.5	10/10/18	11/5/18
Begin RF Amplifier		3	10/10/18	11/5/18
Begin Power Amp		3	10/10/18	11/5/18
Begin Bandpass Filter		3	10/10/18	11/5/18
Labor Cost Schedule	James	2	11/5/18	11/19/18
Poster Draft	James	3	11/5/18	11/26/18
Test/Benchmark Circuits		2	11/5/18	11/19/18
Develop Passthrough Tests		2	11/5/18	11/19/18
Create Quadrature Converter		3	11/5/18	11/26/18
Test Plan	James		11/19/18	11/30/18
Configure LCD/Tuner Knob		2	11/19/18	12/2/18
Implement RF Receive Code		1	11/19/18	11/26/18
Receive/Tune tests		1.5	11/26/18	12/5/18
Transmitting/Tune tests		1.5	11/26/18	12/5/18
Final Preparations for Senior design day		1	12/5/18	12/7/18
Add licensing selection to radio		4	1/22/19	2/19/19
Raspberry Pi implementation		6	1/22/19	3/4/19
Custom PCB		6	1/22/19	3/4/19
Higher Power Amplifier		4	2/19/19	3/12/19
Alternate Power Sources		4	2/19/19	3/12/19
Custom Cases		4	3/12/19	4/9/19
Head phone output jack		4	4/9/19	5/6/19

5. SPONSOR SUPPORT ELEMENTS (SAMUEL HUSSEY)

Sponsor Support Elements		
Element	**First Needed**	**Needed Until**
Sponsor Meeting, at least 1 hour/week	9/17/18	5/6/19
SWR Meter and Dummy Load for testing transmissions	11/26/18	5/6/19
Spectrum Analyzer	11/26/18	5/6/19
Reference Books	9/17/18	5/6/19

6. APPROVALS (JAMES BELL)

The signatures of the people below indicate an understanding in the purpose and content of this document by those signing it. By signing this document you indicate that you approve of the proposed project outlined in this Statement of Work and that the next steps may be taken to create a Functional Specification and proceed with the project.

Approver Name	Title	Signature	Date
	Project Manager		
	D2 Project Manager		
	Faculty Sponsor		
	Sponsor		
	Instructor		

CHECKLIST for Statement of Work

The Statement of Work is graded by your Lab Section Instructor. Grades are individual and NOT team.
Use this as a checklist before submitting your SOW. Comply with each item on this list to maximize your grade.

Elements:
1. **Title Page done correctly** ☐
   - ☐ Logos properly handled
2. **All instructions (red) deleted** ☐
3. **Written contributions of each team member clearly identified** ☐
4. **Table of Contents is correct**
   - ☐ Section numbers retained
   - ☐ Page numbers correct
   - ☐ No tries other than the 6 specified
5. **Executive Summary is clear and concise**
   - ☐ 1/2 to 3/4 of a page - no more
   - ☐ Outlines what you will produce
   - ☐ All bullet items on the template are addressed
6. **Business Need is short and concise**
   - ☐ Clearly states the value of this project
   - ☐ 1/2 a page or less
7. **Product Scope describes the <u>product</u>** (what you'll produce)
   - ☐ **KEY:** You thoroughly researched what your project entails
   - ☐ Key features and characteristics of what you'll design are listed
   - ☐ A table or bulletized list is used to describe the features
   - ☐ The performance is described
   - ☐ How the product meets the business needs
   - ☐ The section speaks only to what you'll produce
   - ☐ Course documents are NOT listed
   - ☐ You will have worked with your D2 Team, and your Sponsor and Faculty Sponsor
8. **Project Scope describes how you will <u>do</u> the <u>project</u>** ☐
   - ☐ A table is used to describe the major tasks needed to finish the project
   - ☐ They are scheduled in a way that makes sense
   - ☐ Each task has a Duration, Start, and End Date
   - ☐ The second semester is included
   - ☐ You show when parts or software is ordered
   - ☐ You show when a prototype will be ready for testing
   - ☐ You show realization that the project must be done (ready to test) before the Characterization Report is due
   - ☐ You will have worked with your D2 Team, and your Sponsor and Faculty Sponsor
9. **Sponsor Support Elements are complete and reasonable**
   - ☐ You thought about what you'd need from the Sponsor and listed each item
   - ☐ The items were general categories
     - ▪ Need specific microprocessor board - good
     - ▪ Need 10 ohm resistor - not good, too detailed
   - ☐ It is clear to the Sponsor exactly what is expected of them
10. **All signatures were present before submitting the SOW** ☐
    - ☐ You worked with your Sponsor in a timely fashion
    - ☐ You gave them plenty of time to review the SOW
    - ☐ Signatures were <u>written</u>, i.e., not typed in