1. Introduction/Project Description:

Many devices are designed such that they can only receive or transmit specific types of waveforms, on a specific range of frequencies. This is due to the Federal Communications Commission (FCC) regulations, and also because old technology is more hardware than software based. Changes can be made to make devices more software based. A recent application has being designed for radio, which is the Software Defined Radio (SDR) technology, which makes possible to convert all the analog blocks of a communication system into equivalent digital blocks to make the system fully programmable. The advantages of making these changes are the low cost implementation, the ability to discover and use the best frequency for the application desired, customization in waveform decoding, and a lot more useful applications to be investigated.

There are different software and hardware that offers the SDR to be flexible and successful. The Universal Software Radio Peripheral (USRP) is a transceiver that functions in any frequency and it is developed to support the GNU Radio Software. This open source software is made to convert all the hardware problems in a radio into software, it runs on a host computer, and consists of a collection of signal processing components. The USRP provides the GSM "Um" air interface to the GSM devices that are considered as a Session Initiation Protocol (SIP) endpoints. GSM (Global System for Mobile Communications), is a standard set developed by the European Telecommunications Standards Institute to describe digital mobile telephony system technologies. GSM digitizes and compresses data, then sends it down a channel with two other streams of user data.

OpenBTS (Open Base Transceiver Station) is an open source application made by UNIX that makes possible the GSM access point, allowing GSM compatible phones to make phone calls without using an existing network communication provider. It uses the USRP as the transceiver which is controlled using the GNU radio as the SDR; also to make possible the route
of calls and text messages, for the authentication and registration of the devices with the network, it is necessary a communication server such as Asterisk.

2. Problem:

With the high cost and maintenance of current cell phone towers, it is not viable for sub-developed countries and communities, where communication infrastructure does not exist, to install high priced com towers. For that reason, an Open Base Transceiver Station takes a roll in the communication system infrastructure as a cell tower by establishing the communication between a cellphone (GSM) and the network created by the station.

3. Purpose:

The purpose of this project is to be able to create an Open Base Transceiver Station to use it as a powerful communication system for those countries that doesn’t have the actual technology to build base stations.
4. Hypothesis:

Using a USRP to create a low powered GSM base station where cell phone users will be able to communicate. The calls will be first connected locally, and then a voice over IP (VOIP) service will be implemented to broaden the connection between the cell phone users. It will be able to use Asterisk as a VOIP server. Asterisk is free, open source software that converts an ordinary computer into a feature-rich voice communications server. Any device that provides an internet connection could be used to establish a connection with the server. All this is needed in order to implement base stations across an area.

5. Methodology:

The steps that will be followed to complete our task will be; the communication prototype will be tested in the laboratory where we will have a control reading and findings throughout the first phase. Second it will be moved throughout the laboratory and the building to test its range and signal clearness, finding the factors of good communication and bad signal. Then it will be mounted on a remote controlled car to test while it moves and between changing environments. If everything points out to be normal in the tests, it will be mounted on the remote controlled UAV to have its final phase of tests on the air and to see if it is viable for a real
environment. In this test it will be submitted to different types of signals and sensors to verify that the signal is not interrupted. When we test the limits of communication and capabilities of the UAV, automation and mission programs will be given to it for more testing and development.
### 6. Budget and Material List:

<table>
<thead>
<tr>
<th>Material</th>
<th>Qty.</th>
<th>Info</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>USRP 1</td>
<td>1</td>
<td>Can be purchased from Ettus Research <a href="http://www.ettus.com">http://www.ettus.com</a></td>
<td>~$700</td>
</tr>
<tr>
<td>Daughterboard</td>
<td>2</td>
<td>It can work with one, but for quality purposes, it will be good to work with 2. RFX1800</td>
<td>~$275</td>
</tr>
<tr>
<td>Antenna</td>
<td>2</td>
<td>One antenna <strong>per</strong> daughterboard. They must match the daughterboards. VERT900 (3dBi Gain) or LP0926 (5-6dBi)</td>
<td>~$35</td>
</tr>
<tr>
<td>52 MHz clock</td>
<td>1</td>
<td>A USRP comes with a 64MHz clock but it’s insufficient in most situations. It serves for better registration of phones. CLOCKTAMER-1.2 (1.1 works too but with limited frequencies) <a href="http://shop.fairwaves.ru/clock-tamer">http://shop.fairwaves.ru/clock-tamer</a></td>
<td>~$250</td>
</tr>
<tr>
<td>Unlocked Mobile Phone</td>
<td>1</td>
<td>Any unlocked phone that supports GSM can be used.</td>
<td>User’s Discretion</td>
</tr>
<tr>
<td>SIM cards</td>
<td>1</td>
<td>One for every phone. It’s best to work with a programmable SIM Card. What you need to know from every card its IMSI. <a href="http://www.nowgsm.com/GSM6in1.htm">http://www.nowgsm.com/GSM6in1.htm</a></td>
<td>~$29 (SIM only)</td>
</tr>
<tr>
<td>SIM card Reader/writer</td>
<td>1</td>
<td>There is a combo pack of one SIM card and a SIM card reader/writer. <a href="http://www.nowgsm.com/GSM6in1.htm">http://www.nowgsm.com/GSM6in1.htm</a></td>
<td>~$49.95 (combo)</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td></td>
<td>~$1,309.95</td>
</tr>
</tbody>
</table>
Projections:

This project will cover the design, development and execution of an Open Transceiver Station (OpenBTS). This base station will be capable of establish the communication between the cellphone of the person in a disaster zone and the central office of 911 with a designated program. This base station integrates advances in Informatics and Digital Signal Processing. It will enable the development of applications that can be used to improve the quality of life of society by helping different organizations whose objective is to help victims of a catastrophe or an emergency. This research proposal will allow undergraduates students to learn more about this application, and help them gain the necessary skills and knowledge to continue advancing the field. The proposed research therefore will open opportunities to the development of new applications and other OpenBTS implementations. Moreover, by working on a brand-new technology, developing practical applications, students will be encouraged and motivated to do research, to improve professional skills, and to surpass the basic knowledge on their education.
Bibliography


http://paparazzi.enac.fr/wiki/Overview