ECE4011/ECE 4012 Project Summary

Project Title	Wireless Communication RF Scanner
Team Members (names and majors)	Sahil Gupta Cameron Karlsson Avnish Kumar Pooja Modi Vatsal Patel Prahlad Venkatesh
Advisor / Section	Greg Durgin/ ECE4012L3B
Semester	2014/Spring Circle: Either Intermediate (ECE4011) or <mark>Final (ECE4012)</mark>
Project Abstract (250-300 words)	The team has designed a wireless communications scanner that will be used in a mobile environment for measuring the RF performance of mobile telephone networks. This device has been prototyped for a company called DasPoint Inc., which uses these transceivers to optimize distributed antenna systems. DasPoint has focused on designing distributed antenna systems for open areas such as football stadiums, college campuses, building complexes etc. It uses these scanners to scan the signals received by these antennas and thereby test its design of distributed antenna systems. The current device they use is bulky and is heavy to carry around to perform vehicle-based or walk-based tests. This product integrates various components needed for the scanner and transmits all the results on an Android device. This makes the whole testing process less bulky and provides real time data. It also provides a much more user-friendly interface to the people conducting these tests, and will give them much more control and debugging tools on-site while they are conducting the tests.

The scanner consists of three major components, namely, Android mobile application, control system, and, the software-defined radio receiver. The Android interface is the first point of communication through which the user enters the frequency and bandwidth of interest. These parameters are then communicated to the control system through a Wi-Fi connection. The control system requests then requests the software-defined radio, which contains the antenna, to read the signal in the user-specified bandwidth and frequency. After this, the control system runs different algorithms on the data to generate final results. Finally the Android application will display the data in a simple user interface.

The device costs about $1500, which includes the cost of the parts and development. The market value for the device will be about $8000. The cost of the device is about the same as the current products in the market, but efficiency of the device will save companies a lot of cost. Using this device requires less manpower and time to analyze a specific network; therefore, reducing operating costs significantly. |

Project Title	Wireless Communication RF Scanner
List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	(i) USB 3.0: was used to communicate between Linux PC and the Nuand Blade RF. (ii) UMTS Protocol: will be monitored in the device to log signal and communication statistics. UMTS signal to noise ratio, RMS signal will be monitored. (iii) Wi-Fi: also known as the IEEE 802.11 standard, Wi-Fi provides a wireless communication interface for nearby communication with data recording devices, or the development PC. Wi-Fi operates in the 2.4GHz frequency range. (iv) HTTP: Internet communication protocol.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	(i) Battery life of the scanner – The scanner is used as walk or mobile tests and need to have a good battery life (ii) Size and weight – Device must be as small and light as possible to ensure portability (iii) Processing speed – Processing speed is a primary constraint. We want the device to be able to process the signals at real time and be able to transmit the data to the user immediately (iv) Cost - Cost is not a major factor for most decisions. We expect the total materials cost to be less than 1k per unit in small (less than 10) quantities.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	While choosing communication protocol between RF Blade and Linux PC, various tradeoffs were encountered. Three different options were considered – USB 3.0, Bluetooth and Wi-Fi. Bluetooth has wireless capability, however it has a poor range and have slower data transfer rate. USB 3.0 has a high transfer rate, however its range is limited by the length of the cable. Wi-Fi has high data transfer rate as well as very high range, however, there must be an internet or local connection available in the area. For the project, Wi-Fi was chosen as our primary design constraint is processing speed. Another tradeoff we faced was between frequency range and processing speed. Blade RF and Hack RF were two different software defined radio that was considered for the project. Blade RF has a frequency range from 300 MHz to 3.8 GHz, whereas Hack RF has a frequency range from 10 MHz to 6 GHz. However, Blade RF has a higher processing speed and has USB 3.0, whereas Hack RF have only USB 2.0. For this project, Blade RF was chosen as UMTS protocol works in the frequency range of Blade RF, and Blade RF has a higher processing speed.
Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or	Increasing the processing speed to do computation regarding signal measurement is the key to making testing experience smooth for the scanner. Algorithms that compute signal strength, power level, quality level and other parameters along with filtering of cellular network signals will require very fast DSP microcontrollers/embedded computing systems. The processing will take place either on-board chip on the mobile station

interactions. *Complete if applicable; required if team includes CmpE majors.*	(MS)/wireless scanner or interface (mobile device/desktop/laptop) depending on the processing power needed, user convenience in using the MS/wireless scanner and inter-device communication between MS and the interface. Possible interfaces involved in the wireless scanner are mobile device, desktops and/or laptops. These devices will display: 1) The results of signal measurement done for the cellular network involved. 2) RF snapshot of the signals captured from the cellular network. Nuand RF Blade was chosen as the software defined radio of the scanner. Since, Nuand RF Blade has high processing speed and has USB 3.0. It will be useful in running algorithms mentioned above. The platform chosen to provide mobile interface for reading the signals is Android. Since Android is open-source and has a large user base, developing front-end application in this platform gives us an edge over using other platforms.