Utilizing Radio-Frequency Energy in Wireless Sensor Networks

Rohithram R	EE16B031
Rishhanth Maanav V	EE16B036
Lokesh Kumar T	EE16B040

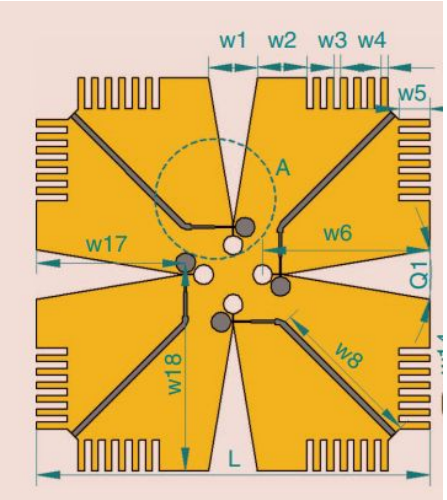
Introduction

- For developing autonomous and energy-efficient sensors is vital. For an autonomous system, one important factor is the power supply.
- One appealing solution is to use the ambient RF energy that exists in a modern city environment from all of the wireless services, such as cell phones, Wi-Fi, and digital TV.
- Harvesting the ambient RF energy in a city environment has advantages because it does not depend on such uncontrollable external factors as solar energy or wind power.

Project Objectives

- Consider the subproblem of harvesting cellular energy
- Simulate a Cellular Rectenna System to power wireless sensor networks using RF Energy
- Simulate the far-field of a Linear Tapered Slot Antenna
- Simulate the performance of Cellular Rectifier
- Build a cellular rectenna system consisting of 8 Linear Tapered Slot Antennas and 8 rectifiers
- Determine the efficiency of the rectenna system by varying its load

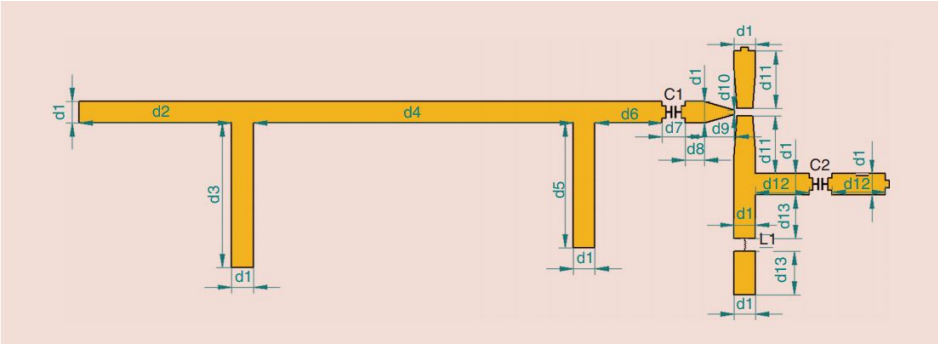
Linear Tapered Slot Antenna



The layout of a set of four LTSAs

- The set up involves four LTSAs arranged as shown in the figure.
- We build a similar module of the LTSA set-up and simulate its far field.
- We initially do so with a model without corrugations
- Then, we do the same with the corrugations in place
- We try to see the improvement in gain and reduced sidelobes.

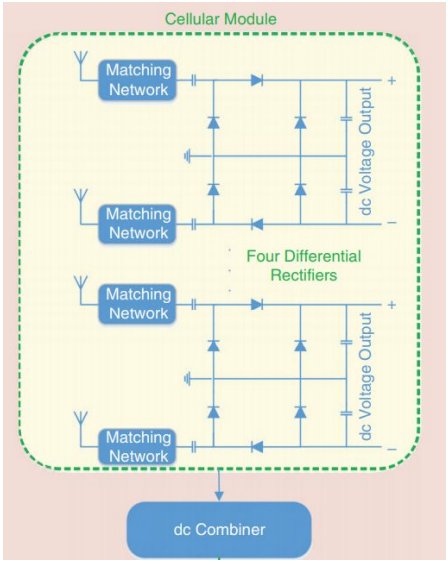
Cellular Rectifier

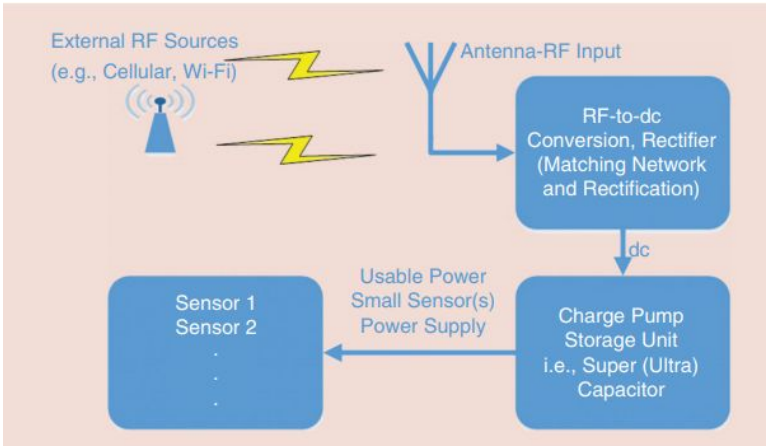


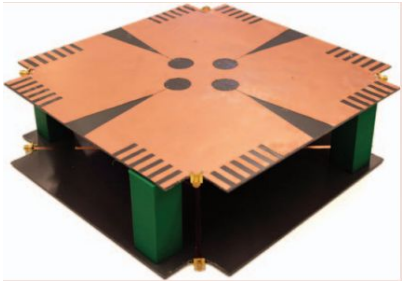
A cellular rectifier

- We build module for a rectifier consisting of two half T-networks (as shown in the figure) to match the 2 cellular bands: 3G, 2.1 GHz, and GSM, 1.8 GHz as suggested in reference [1].
- We characterize the rectifier's performance by simulating the following: S11 parameter, Voltage characteristics and efficiency vs load resistance for both the frequency bands.

Cellular Rectenna System







Cellular Rectenna System

- Using a total of a pair of the LTSA combination (4 sets each) and 8 rectifiers (4+4) we build a cellular rectenna system.
- Using cellular bands at 3G (2.1 GHz) and GSM (1.8 GHz) and varying the load at the DC output of the system, we determine the efficiency of the system at different loads.

Resources and References

1. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8485670
2. http://www.microwavejournal.com/articles/6406-analysis-and-design-of-a-linearly-tapered-slot
3. http://rfic.eecs.berkeley.edu/142/pdf/module6.pdf
4. https://pypi.org/project/PyNEC/ (for antenna simulation)
5. http://scikit-rf-web.readthedocs.io/ (rf toolkit)

Thank You!!