A Narrowband Rectenna Design for Harvesting Ambient RF Power

Project Overview:

Nowadays, there is an increased demand for green energy sources that can be used as an alternative for fossil fuels. Examples of green energy include Wind and Solar energies. However, these energies are costly and require regular maintenance and follow up. Another form of green energy is the Radio Frequency energy that is available from the unused emissions of the base stations, Wi-Fi signals and different sources across the electromagnetic spectrum. These radiations can be used to power different electronic devices. Although the available RF power is low, it can be used to power low-energy devices. However, careful design of the harvesting system components is required to maximize the system efficiency.

A block diagram of a RF harvesting system is presented in Fig.1, which consists of a rectenna (rectifying antenna), a power management and storage unit to control the harvested energy and finally the target application such as sensors. For the rectenna, in order to maximize the power transfer from the antenna to the rectifier, a matching network is usually required to match the antenna impedance to that of the rectifier, which adds losses from its components and degrades the system efficiency.

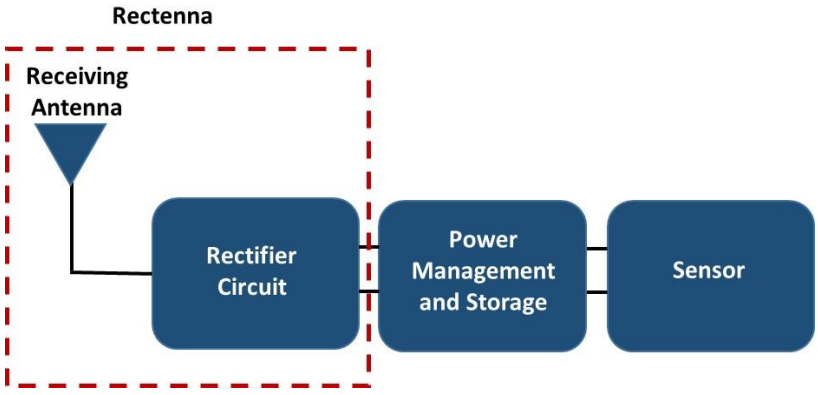

Fig. 1: components of an RF harvesting system

Hence, this project aims to design and test a rectenna system that can harvest power available from cellular bands such as GSM 900 and GSM 1800, while eliminating the use of matching networks to reduce system losses. This can be achieved by optimizing the antenna design to be the complex conjugate of the rectifier impedance. A study will be also conducted to investigate the losses associated with different rectifier topologies and the different diode types.

Tasks:

- Survey on various rectifier topologies
- Design and fabrication of different rectifier layouts
- Testing the implemented layouts with different commercially available Schottky diodes, to compare between them in terms of output dc power, and efficiency
- Integrating a suitable antenna (optimizing its parameters) to test the complete harvesting system

Eligible Departments:

Electronics	**X**
Communications	**X**
Networking	

Software/Hardware:

- Advanced Design system (ADS)
- CST Microwave Studio

Relevant References:

- David M. Pozar, “Microwave Engineering”, 3rd Edition, Wiley.
- Constantine A. Balanis, “Antenna Theory: Analysis and Design, 3rd Edition”, 3rd Edition, Wiley-Interscience.