An Evolved Rectenna for Wireless Sensor Networks
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Overview
What if you could charge your smartphone's batteries wirelessly by collecting ambient energy in the air? That's the promise of the rectenna. A rectenna is a device that collects incident electromagnetic radiation and converts it to DC power. In this work, we design and optimize a rectenna for RF energy harvesting at 2.45 GHz. The rectenna is used to power a sensor system from the wirelessly transmitted energy.

Antenna Rectifying circuit

Sensor System

![Diagram of Antenna Rectifying circuit and Sensor System]

Antenna
Optimized by a genetic-algorithm based tool
**Optimization objectives:**
- omnidirectional radiation pattern
- 50 Ohm impedance at 2.45 GHz
- suppression of harmonics at 4.9 and 7.35 GHz
- 50 MHz bandwidth
Best found design: planar inverted F antenna (PIFA)

Rectifying Circuit
Optimized in the Agilent Circuit Simulator
**Optimization objectives:**
- Maximize RF to DC power conversion efficiency for the RF input power of 10mW
- Minimize cost by using standard technology
PCB
Best found design: 40% rectification efficiency

![Graph of S11 at the input terminals of the evolved PIFA]

![Graph of Output voltage at the load of the rectifier as a function of the RF input power]

Results/Conclusion
- We optimized a rectenna and validated its performance in RF energy harvesting by powering a sensor system
- With 4dBm RF input, it takes 30s to charge the battery to 2.2V and power up the sensors
- After the power-up, the sensor system stays on with as low as 0dBm RF input

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