

Energy Harvesting Through Radio Frequency System

Damini Verma

B.tech Scholar

Department of Electronics and Communication
Vivekananda Institute of Technology
Jaipur, Rajasthan, India

Mr. Neeraj Sharma

Assistant Professor

Department of Electronics and Communication
Vivekananda Institute of Technology
Jaipur, Rajasthan, India

Abstract—Radio frequency is the frequency range used in radio, extending around twenty thousand times per second (20 KHz) to around three hundred billion times per second (300 kHz). Recent enhancement in science and technology provide advancement in semiconductor technology which helps in fabrication of various energy systems. Fabrication process enables awareness of the idea of Radio Frequency (RF) energy harvesting. This energy harvesting through radio frequency is a growing research and technology area that run low-power wireless devices by producing energy. It is a process of converting electromagnetic waves into applicable electrical energy from the energy contained in electromagnetic waves which will help you realize permanent operating sensors. This paper presents the detailed aspects of current research on Radio Frequency energy harvesting circuits and protocols. We will also discuss the causes and impact of energy furnishment capability of this system.

Keywords—Radio frequency, energy harvesting, operating sensor, fabrication, protocols.

1. INTRODUCTION

Energy harvesting technologies objective is to convert extensive environmental energy into helpful electricity to strength a broad range of wireless devices. Energy harvesting system clasp hopeful future to be an energy source for low power electronics device. The ability to power mobile electronics and wireless sensor devices has greatly spurred energy harvesting research. Basically, this type of energy harvesting system is contemplated to operate with relatively small input powers. The system depends on state-of-the-art electrical technology for obtaining high efficiency.

In this research, exclusive attention is given to radio frequency (RF) energy harvesting as a green technology, which is very suitable for overcoming problems related to wireless sensor kink located in drastic environments or inaccessible places. In this system, a simple RF energy harvesting system is prepared on FR4 substrate and the harvesting circuit uses a single diode as the purification circuit and a Super capacitor for the energy storage device and the transmitted signal which is thermoelectric energy harvesters. Electromagnetic wave has been chosen as the energy source for the introduced harvesting system. Energy harvesting WSNs are the basic technology which is currently revolutionizing application spaces such as environmental invigilates health monitoring, industrial automation, health and medical smart systems. In the above mentioned applications, it has been proved that ambient Radio Frequency energy-harvesting technologies can be easily

integrated with other energy harvesting systems such as piezo electric energy harvesters, solar energy.

This review paper gives a brief outcome on RF energy harvesting sources aimed at powering low energy wireless sensor devices. The paper is organised as follows: section 2 presents schematic of RF energy harvesting while section 3 gives a state of the art review of RF energy sources. Section 4 presents the high lighting future approach and research directions, finally section 5 concludes the paper.

2. RF ENERGY HARVESTING METHODOLOGY

The proposed enegy harvesting system is represented in a block diagram. The diagram is stated in figure given below. As shown in the figure, the receiving antenna collected the transmitted signal from the satellite. In lineal RF energy harvesting systems, the escapement of RF power is realised by receiving an RF signal using an antenna.

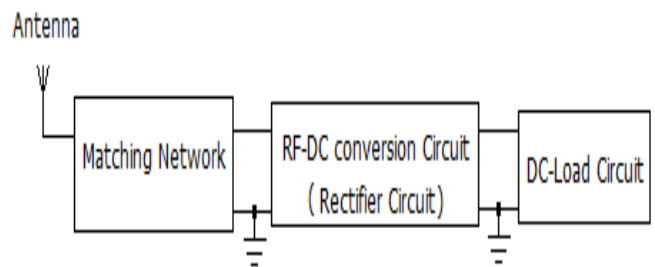


Fig.1 Schematic of RF energy system

Then the RF signal is rectified to produce the desired direct current (DC) which is then conditioned to power an external circuit or device. An impedance matching circuit is needed, to effectively operate the RF energy received by the antenna. The impedance matching network interrupt the reflection of RF energy in free space and help to boost the RF signal voltage power as well as the peak input voltage to the rectifier circuit.

3. RF ENERGY SOURCES

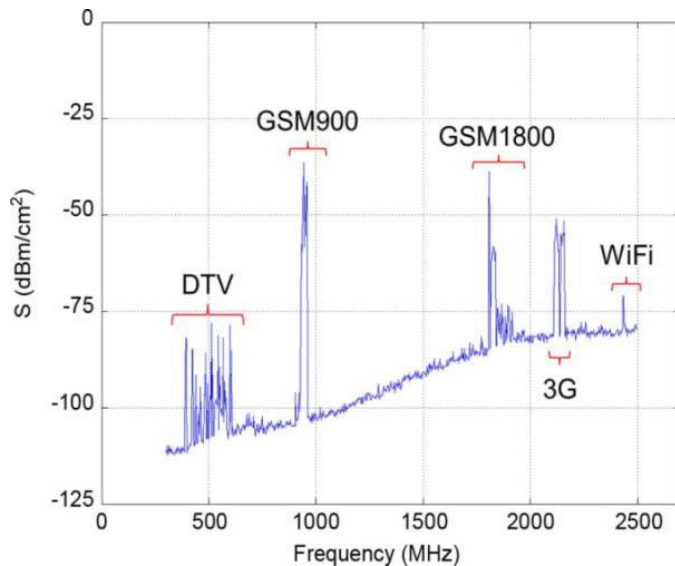


Fig. 2 Typical RF power densities

In this section GSM/Cellular, Wi-Fi and TV/DTV radio frequency sources are presented as the main sources for harvesting RF energy. Fig. 2 shows RF power densities of these main RF energy sources as measured from outside the Northfields London Underground stations. From fig. 2 GSM 900/1800bands have high RF power densities. There are many other sources also but they are limited that's why we used these sources.

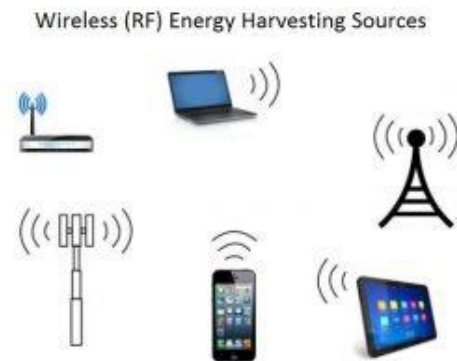


Fig.3 RF energy sources

3.1 MOBILE BASE STATION/GSM/CELLULAR SOURCES

As can be seen through the past two decades have witnessed splendid growth of mobile phone (cellular) communications, and there are currently in use of 7.3 billion mobile phone subscribers in the world. The elaboration of cellular phone networks entails an increase in base stations. Moreover, with this growth comes the indispensable increases in the number of base station sites. Base stations and cellular phones are factually two-way radio systems and they produce RF radiation to communicate. During the communication of base stations and mobile phones with each other, they share a range of operating frequencies. As we know in the Global System for Mobile (GSM) communication system, the main

operating frequencies are 900 MHz (called GSM900) and 1800 MHz (called GSM 1800).

3.2 Wi-Fi RF SOURCES

The Wireless Fidelity (Wi-Fi) is a very advanced and short-range wireless transmission technology used to intercommunicate laptops, personal computers, small mobile- personal digital assistant (PDA), smart phones and other such terminals. In IEEE802.11 standards the Wi-Fi for wireless local area networking (WLAN) and was contemplated for interoperability based on the standards between wireless network products. Wi-Fi uses the unauthorised Industrial Scientific Medical radio band (ISM) of 2.4 Hz to 5 GHz AND the intension for designing Wi-Fi technology was mainly for indoor applications reformed for a coverage distance of 100 metres. An advanced development which is recently taking over this area is the vast deployment of Wi-Fi in habitable and public areas known as hotspots where Wi-Fi internet access is publicly availed. Hotspots are often found in restaurants, coffee shops, college campuses, hotels, airports and other public areas where there is high demand for wireless internet access.

3.3 TV AND DTV SOURCES

RF energy harvesting from earthly TV broadcasting has become an attractive area for researchers in the coming days. A number of researches were recorded in the period expanding from 2009 to 2015. Intel Research proved may be the first major demonstration of RF ambient power harvesting from Digital Television (DTV) in 2009, when 60 μ W of energy was harvested at a distance of about 4 km from a 960-kWTV broadcasting tower. Mikeka et al presented an RF energy harvesting rectenna with conversion efficiency of 18.2% for -20 dBm input and 0.4% for -40dBm input, respectively. They reported power of -44 dBmand +3 dBm as measured from Tokyo TV broadcasting towers at 400 m and 4 km respectively. In 2013, Parks etal successfully powered a wireless sensor platform with energy harvested from a 500-MHz digital TV (DTV) broadcasting radio wave. Thses signals are unnaturally produced and are neutrally independent of weather (as is the case with solar energy) and these signals are broadcast 24 hours and hence have potential to be a sustainable source of ambient energy.

4. APPLICATION AND FUTURE APPROACH

4.1 Applications of wireless energy harvesting

- It is a Battery-less power source.
- It has Smart lighting applications.
- With the use of ZigBee technology it produces Smart switches for home automation.
- Lots of IOT applications
- Recharging of devices
- Provide power source for smart sensors.
- Simple design and cost effective.
- Implementation is easier.

4.2 Future of wireless energy harvesting

There are lot of future aspects and potential for wireless energy harvesting for application like Internet of Things and

home automation projects and many others. Like Smart sensor technology is adequate of producing low power devices with developed embedded technology which typically prevail at micro watt input power. Wireless sensors for temperature, moisture and proximity sensors are used in industrial, home automation and automobile industry in many ways. With advancement in wireless energy harvesting technology wire-free charging of any electronics device would be possible.

Our future mobile devices will be adequate of using wireless charging technology as an alternate power source whenever they need. Wearable devices and medical sensors will be using wireless energy as power source that is a good initiative. Advanced security devices with smart sensor technology can make use of power from wireless energy harvesting. It has many advantages due to wire-free wireless transmission, compact size and the modules can be easily implemented anywhere we want.

5. CONCLUSION

In conclusion, the upcoming technologies like Internet of Things will require adept energy source to connect billions of smart devices and sensors for broad spectrum of applications in technologies.

This long term sustainable and reliable energy sources are inevitable for any efficient system. This type of energy harvesting is an area for future developments to convey effective solutions for IoT, medical, industrial and other smart applications in homes.

This paper presents a brief review of RF energy harvesting sources, highlighting the key achievements and future

aspects. The modification efficiency of RF energy harvesting systems at low input RF power is currently very low and hence particular research efforts at renovating this performance metric is a key milestone in fetching practically viable rectenna systems for real world expansion. The power delivered by RF energy harvesting devices has significantly increased, it is still critical to note that the intended applications are essentially ultralow power wireless sensor devices which do not support computationally intensive algorithms. Then a new energy harvesting system is proposed in that research by using commercial ASTRO antenna.

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