

# Advanced Wireless Power Transmission

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**Abstract - Solar energy transmitting satellites (SETS) convert solar energy into electromagnetic waves and send these microwaves to a beam to a receiving antenna on Earth for conversion into ordinary electricity. SETS is a clean, stable and large-scale electrical energy source. Wireless power transmission is essential for future space power harvesting. WPT contains a microwave beam that can be directed to any desired location on the earth's surface. This ray collects solar energy and converts it into electrical energy. This concept is more advantageous than conventional methods. The SETS will be a central attraction of space and energy technologies in the coming decades. This project offers an analysis of wireless energy transmission with an assessment of its practical applicability in terms of power range and efficiency. Wireless energy transmission is a useful and practical technology that allows solar energy (renewable energy) to be collected and concentrated on the earth's surface without the need for a cable connection.**

**Keywords:** Solar Power Satellites (SPS), stable electric power source, Wireless power transmission, Solar Energy, electromagnetic spectrum, Renewable energy, Wireless power transfer.

## I. INTRODUCTION

Recently, wireless power supplies that supply wireless (in-air) electrical power to devices without a power cord or the like have come into practical use. The principles by which wireless electrical energy is transmitted are generally divided into three types:

- Electromagnetic induction type
- Radio reception type
- Resonance type

The contactless energy transmission by electromagnetic induction uses the phenomenon in which the application of an electric current to one of the neighboring coils induces an electromotive force in the other coil with a magnetic flux as a medium.

Wireless energy transfer (WPT) is an innovative technology that supplies communication devices with no

power supply. With the remarkable advances that have been made recently, this technology has attracted much attention from scientists and research and development companies around the world. Recently, the use of mobile devices such as cell phones, PDAs, laptops, tablets and other portable devices that are equipped with rechargeable batteries has become widespread.

It is known that electromagnetic energy is associated with the propagation of electromagnetic waves. In theory, we can use all electromagnetic waves for wireless energy transmission (WPT). The only difference between WPT and communication systems is efficiency. Maxwell's equations indicate that the electromagnetic field and its power diffuse in all directions. Although we transmit energy in a communication system, the transmitted energy diffuses in all directions. Although the received power is sufficient for the transmission of information, the efficiency of the transmitter to the receiver is silent. So we don't call it the WPT system.

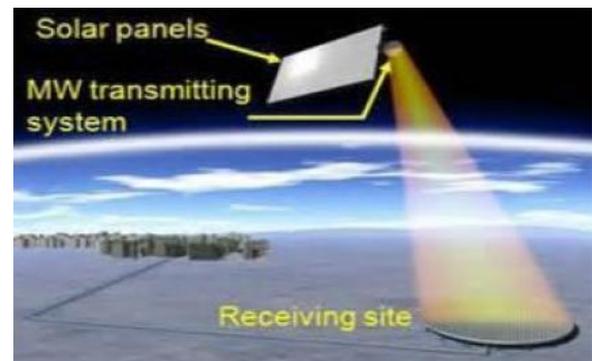


Figure 1: Point-to-point power transmission

The typical WPT is a point-to-point power transmission. For WPT, we should better focus the performance on the recipient. It has been shown that the energy transfer efficiency can be almost 100%. With the conical method of transmitting the antenna power distribution, we can further concentrate the microwave power transmitted to the receiver opening areas. The famous power cones of the transmitting antenna are the Gaussian cone, the Taylor distribution and the Chepachet distribution. Such a cone of the transmitting antenna is usually used to suppress the side lobes. Corresponds to increased energy transfer efficiency. There are good optical approaches

in Russia with regard to the energy transfer efficiency of WPT.

The most suitable and future application of WPT by microwaves is a space solar energy transmitting satellite (SETS). The SPS is a gigantic satellite designed as a power plant that orbits the Earth's geostationary orbit. It mainly consists of three segments; Solar collector for converting solar energy into direct current, direct current converter in microwaves and a large number of antennas for transmitting microwave power to the ground. The first solar collector can be photovoltaic cells or solar thermal. The second stage microwave-to-DC converter can be a microwave tube system and / or a semiconductor system. It can be your combination. The third segment is a gigantic antenna network.

Some typical parameters of the PLC transmit antenna. An amplitude cone is used in the transmitter antenna to increase the efficiency of the beam collection and to reduce the level of the side lobes in almost all PLC designs. A typical amplitude cone is called a 10 dB Gaussian value, in which the power density in the center of the transmitting antenna is ten times the edge of the transmitting antenna.

The PLC is expected to be operational around 2030. Other WPT applications may be considered before the PLC completes. In recent years, mobile devices have made significant progress and require a reduction in energy consumption. This means that we can use little diffuse microwave energy as an energy source for mobile devices with low power consumption such as RF-ID. The RF-ID is a radio tow tractor with wireless transmission of energy and wireless information. It is a new WPT application like streaming.

A Wireless Power Transfer (WPT) system transfers power to the device, which must work wirelessly and is the key subsystem of the future fractionation system for fast, flexible and free flight (F6). WPT technology is very important for space solar energy and space exploration and could exceed the capacity and operational limits of satellites, making them much lighter, smaller, more flexible and more durable. In addition, the WPT system could transfer energy to a spacecraft to power the interstellar probe. The WPT system currently uses the microwave and laser as a means of energy transmission.

The composition of the WPT system is shown, which includes the energy transmission subsystem, the energy reception subsystem, the energy management subsystem and the beacon targeting subsystem. The power transmission subsystem uses a higher power laser or microwave energy source that generates a laser or microwave beam and then

emits it into space through antennas. When the laser or microwave beam reaches the receiving subsystem, it is received by the antenna array and transmitted to electronic energy. The energy management subsystem has converted the unstable electrical voltage into amplitude sufficient to supply the payload or to charge the batteries. To improve transmission efficiency, the power transmitter subsystem and the receiver subsystem must be coaxial, and the beacon targeting subsystem is finally introduced. It uses acquisition, tracking, and targeting technologies to achieve precise goals.

## II. REVIEW STATUS

In 1864, James C. Maxwell predicted the existence of radio waves using a mathematical model. In 1884, John H. Poynting recognized that the Poynting vector would play an important role in the quantification of electromagnetic energy. In 1888, Heinrich Hertz, reinforced by Maxwell's theory, succeeded in providing experimental evidence for radio waves through his spark radio transmitter. The prediction and detection of radio waves in the late 19th century marked the beginning of wireless energy transmission.

During the same period as Marchese G. Marconi and Reginald Fessenden are the pioneers of radio wave communication. Nikola Tesla proposed an idea for wireless energy transmission and conducted the first WPT experiment in 1899 [1] [2]. He told that: "This energy is collected all over the world, preferably in small quantities, from a fraction of a horse to a few. One of their main uses will be the lighting of individual houses which actually have a gigantic role. It was built with one 200 foot high mast connected with a ball 3 feet in diameter at the top The Tesla coil, which resonated at 150 kHz, delivered 300 kW of power and the RF potential in the upper ball reached 100 MV.

Unfortunately, it failed because the transmission power with radio waves of 150 kHz, the wavelength of which was 21 km, spread in all directions. In order to concentrate the transmitted power and increase the efficiency of the transmission, we have to use a higher frequency than that used by Tesla. In the 1930s, thanks to the invention of Magnetron and Klystron, great strides were made in the production of high-performance microwaves, namely radio waves with 1 to 10 GHz. After the Second World War, high-performance microwave tubes with high efficiency were developed through the development of radar technology. We can concentrate the power at the receiver with microwaves. We call wireless microwave energy transmission microwave energy transmission (MPT). Based on the development of microwave tubes during the Second World War, W. C. Brown began researching and developing MPT in 1960.

He first developed a rectenna, a rectification antenna he named, to receive and correct microwaves. The efficiency of the first Rectenna developed in 1963 was 50% at the 4WDC output and 40% at the 7WDC output.

With the rectenna, he successfully completed MPT experiments with a cable helicopter in 1964 and with a flying helicopter in 1968 (Fig. 1). In 1970; He tried to increase the overall efficiency of DC-RF transmission-RF-DC using a 2.45 GHz microwave. In 1970, the overall DC-DC efficiency at 39 WDC at the Marshall Space Flight Center was only 26.5%.

In parallel, he and his team successfully completed the largest MPT demonstration on the Venus site of the JPL Goldstone installation in 1975 (Figure 2). The distance between a 26 m diameter satellite dish and a 3.4 mx 7.2 m rectan arrangement was 1 mile.

After the 1990s, numerous laboratory and field MPT experiments were carried out worldwide. We often use 2.45 GHz or 5.8 GHz of the ISM band (ISM = Industry, Science and Medicine) for the MPT system. In 1987, a Canadian group demonstrated an aircraft-less flight experience with MPT called SHARP (stationary relay platform at high altitude) at 2.45 GHz.

### III. PROPOSED METHODOLOGY

The proposed system presents the concept of satellites that generate solar energy. The satellite's solar cells convert sunlight into electricity, which is converted into radio frequency energy and then transmitted to a receiving location on Earth. The receiving antenna converts it to electricity and the energy is routed to our normal power distribution network for use here on Earth.

#### 3.1 Block Diagram

This system offers a wireless power transmission design with an assessment of its practicality in terms of performance.

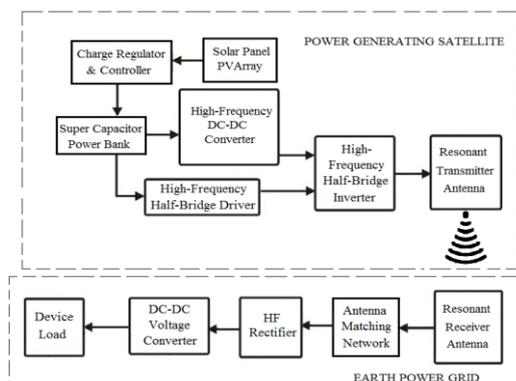


Figure 2: Block diagram of proposed system

The super capacitor bank provides more stable performance without fluctuations. Here we use electromagnetic FM waves that are safe and environmentally friendly at higher power levels.

#### 3.2 Solar Panel PV Array

Photovoltaic solar modules collect light radiation from space and convert it into electrical DC power.

#### 3.3 Charge Regulator & Controller

The charge controller monitors the charging current and the charging voltage of the solar panel output and stores them in the battery bank.

#### 3.4 Super Capacitor Bank

The series of super-capacitors stores the electrical energy of the solar modules and supplies the converter.

#### 3.5 High Frequency Converter

High frequency converter consists of a high frequency oscillator which generates PWM pulses and drives the MOSFET's. Here two separate PWM pulses PWM1 and PWM2 are produced and supplied to the MOSFET gate.

#### 3.6 Half bridge Driver

Half bridge driver consists of a High frequency transformer which converts the DC current from the MOSFETs to a high frequency AC current. The primary of the HF transformer is connected to the MOSFETs and secondary connected the transmitting antenna.

#### 3.7 Resonant Transmitter Antenna

The transmitter antenna is equipped with windings made of copper coils that convert high-frequency oscillating electrical current into electromagnetic waves that vibrate at a certain frequency.

#### 3.8 Resonant Receiver Antenna

The receiving antenna receives electromagnetic waves from the transmitting antenna and is converted into a high frequency electrical output.

#### 3.9 Antenna matching Network

It matches frequency of the oscillator with the frequency of the antenna to maintain resonance tuning of the receiver and transmitter.

### 3.10 HF Rectifier

HF rectifier consists of fast switching rectifier diodes which converts HF voltage into DC voltage and filters the output voltage which is utilized by the loads.

## IV. RESULT ANALYSIS

The hardware prototype is developed and the power transmission is achieved wireless between the transmitter and receiver units. At the transmitter side 12V DC is supplied from the power source.

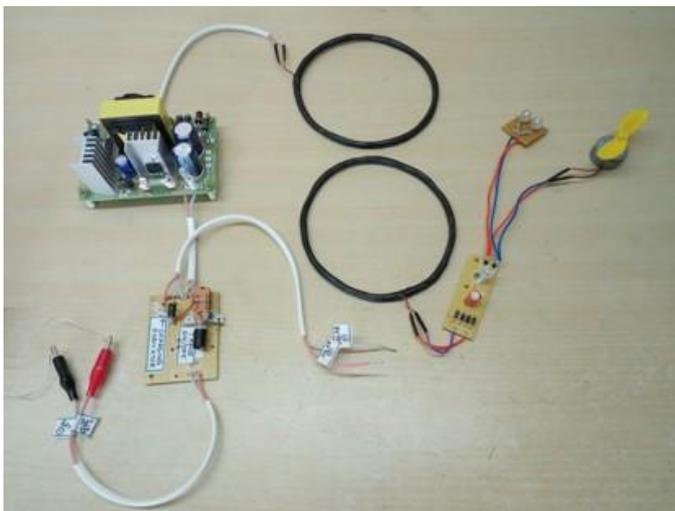


Figure 3: Prototype of WPT hardware

A DC voltage of 12v is obtained at the receiver output with a maximum power of 15W is obtained. The image of prototype hardware is figure.

## V. CONCLUSION

Solar energy is a very efficient and reliable alternative to the existing fossil fuels for the development of a future sustainable carbon-free fuel economy. Thermo chemical and biological conversion processes are promising technologies with high yield potential. The most obvious problem for the PLC concept is the current cost of room starts. However, solar energy has great potential to form a significant part of a future carbon-free energy portfolio. The use of solar technologies for large-scale energy production requires the participation of political and economic actors, but also further improvements in conversion efficiency and lower manufacturing costs. A major ongoing research effort is aimed at finding innovative solutions to overcome these obstacles. In the past ten years, photovoltaic technologies have undergone an astonishing development that has increased the efficiency of silicon crystal solar cells by up to 95%.

## VI. APPLICATIONS OF THE PROJECT

- Wireless energy has a bright future in wireless power supply. There are no restrictions on power supply applications. Some of the potential applications concern the power supply of mobile phones, laptops and other devices that normally work with batteries or cable connections.
- Wireless power applications should run on devices near a wireless power source that automatically charge the devices without having to be connected.
- If you use wireless energy, you do not need batteries or remember to charge the batteries regularly. When a source is placed in each room to supply electricity to the whole house.
- Wireless energy has many medical uses. It is used to power many commercially available medical implantable devices.
- Another application of this technology involves the transmission of information. It does not interfere with radio waves and is inexpensive and effective.

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