Wireless Transmission of Electricity

D. Sabareesh
Dept of ECE-
Periyar Maniammai Inst of Science & Tech

J. Issac Timothi
Dept of ECE-
Periyar Maniammai Inst of Science & Tech

Abstract:- **The transfer of power from source to receiver is a technology that has existed for over a century. Wireless power transfer (WPT) has been made feasible in recent years due to advances in technology and better implementations of transfer techniques, such as Microwave Power Transfer (MPT).The MPT system works by converting power to microwaves through a microwave generator and then transmitting that power through free space where it is received and converted back to power at a special device called a rectenna. The applications of MPT are numerous, not only to change the way existing technologies work, but also as theoretical constructs for future constructs. While the benefits are great, there are many limitations and drawbacks of MPT, necessitating the discussion of possible alternative methods for WPT. The transfer of power wirelessly has the potential to completely disrupt and revolutionize existing and future technologies.**

Keywords-Wireless Power Transfer, Microwave Power Transfer, Rectenna, Solar Power Satellites, Highly Resonant Wireless Power Transfer.

1. INTRODUCTION

The transfer of energy from a source to a receiver has traditionally necessitated the use of a physical connection. Indeed, electrical grids and power outlets span nearly the entire globe and deliver power to billions of people worldwide. Recently, there has been much interest into the area of wireless power transfer (WPT), that is, the transmission of power without the need for a physical connection. Research into WPT, however, is nothing new, as experiments in the field took place as far back as Nikola Tesla in the early 20th century.

The aim of this paper is to provide an overview of WPT, with a focus on the radiative approach to wireless power; that is, transmitting power using the electromagnetic spectrum. In particular, this paper details the transfer of power over the microwave band, called microwave power transfer or microwave power transmission (MPT).Section 2 of this paper provides an overview of the fundamentals of wireless power, detailing MPT and how it works. Section 3 outlines and highlights some key and interesting applications of wireless power. Section 4 poses some limitations, drawbacks, and potential safety concerns of MPT.

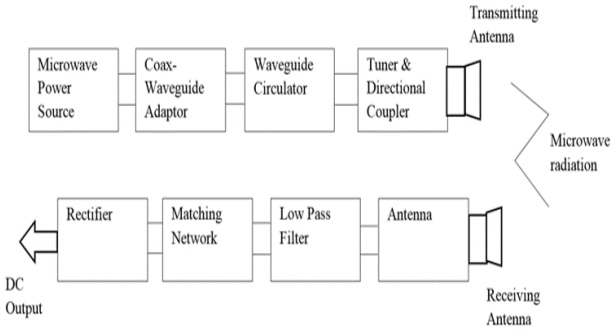
WPT is an extremely useful technology that has numerous applications and benefits. Cell phones, laptops and other mobile devices could function without ever having to be plugged in, cars could drive on highways burning no fossil fuels; wireless power even has the potential to solve much of the renewable energy issues we face.

2. FUNDAMENTALS OF WIRELESS POWER TRANSFER: MICROWAVE POWER TRANSFER

Transfer of power via microwaves has long been the focus of study and experimentation. In the early 1900s, Nikola Tesla experimented with transmission of power wirelessly, through microwaves. His work, however, was largely left unimplemented, as his experiments were vastly ahead of their time and the technology did not yet exist to make WPT via microwaves feasible. Advances in wireless technologies since Tesla, however, have made possible that which was not in the early 20th century. Described in this section are the details of those technologies behind MPT as a mechanism for WPT.

2.1 OVERVIEW OF THE SYSTEM

As mentioned above, MPT as a mechanism for WPT is the central focus of this paper. MPT is defined as the transfer of power through space by means of microwaves. In particular, a MPT system converts direct current (DC) power to microwaves, transmits that microwave radiation to a target, and the target converts the microwave radiation back to DC power . Figure 1 below depicts a block diagram of the MPT system. First the microwaves are generated by the microwave generator. This radiation then passes through the Coax-Waveguide Adapted, which in turn passes through the waveguide circulator, a device that reduces the radiation to exposure from outside power. Finally the radiation passes through the tuner and directional coupler device, which separates the signal according to signal propagation direction. The radiation is then transmitted over the air through antennae, where it is received by the antenna at the rectenna, at which the microwave radiation passes through a low pass filter, then a matching network, then a rectifier as it is converted to DC power . The details of the relevant steps are described in the sections to follow.



Block Diagram of MPT

3. APPLICATIONS OF WPT

Several applications of wireless power transfer are apparent and obvious. Firstly, WPT could eliminate traditional charging systems in place today. Instead of plugging in a mobile phone or laptop via power cord to charge the battery, wireless power can be harnessed and implemented in a home such that a laptop and phone charge continuously and wirelessly without the need for plugging anything in. Higher level applications include charging of electric vehicles (EVs). As EVs become more and more prevalent on the roads, the feasibility of driving such a vehicle can be maximized via stationary, and even mobile, WPT systems. Future and theoretical applications include a potential solution to renewable energy for the planet, by means of satellites collecting sunlight and sending power back to earth through MPT. Applications of WPT are described in this section.

3.1 ELECTRONIC PORTABLE DEVICES

Cell phones, laptops, tablets, even smart watches are found all over the globe and are owned and used by billions of people. What these devices all have in common is the need to recharge their internal battery so that the device can be used while mobile. Such is the paradox of portable devices: they provide convenience by running off internal power so they can be used anywhere, but always must return to be tethered to a power cord in order to charge.

WPT has the potential to disrupt and revolutionize the traditional portable device, not only by making mobile devices more convenient by eliminating the need for a physical power supply, but also safer (power cords carry risk of shock and can cause fires), as well as a reduced cost for consumers . Research has even been done into multi-hop WPT systems, wherein a generator transmits power wirelessly to targets, which can then in turn become sources for other targets, and transfer power wirelessly to those targets. Thus, a network of WPT can be created to support several devices.

4. LIMITATIONS AND DRAWBACKS OF MPT

MPT hinges upon microwaves being transmitted through the media of open space from source to target. While efficiency of conversion of power to and from microwaves has been discussed above, one of the variables of transfer through the use of microwaves is the media through which it travels. Thus, the ability to efficiently transfer microwaves through open space is dependent on whether or not a clear line of sight exists between source and target. Factors such as weather and physical objects can obstruct the line of sight between source and target and can inhibit the transfer of power via microwave. Additionally, as discussed in the case study of the charging of the electric vehicle above, beam forming and focusing the microwave radiation is vitally important for an efficient WPT system. It follows, therefore, that the transfer of power from a source to a moving object, especially at longer distances, would be extremely difficult to do so with a highly directional antenna, and would be inefficient to the point of impracticality with an omni directional antenna.

Therefore, systems wherein a target or source or both are in motion are not ideal for WPT by means of MPT.

5. CONCLUSION

The focus of this paper has been an overview of the MPT mechanism for WPT, and its aim has been to highlight the many benefits and applications of MPT. The discussion began by describing and defining the fundamental aspects of the MPT system. This was followed by a look at the many applications of MPT to wirelessly transfer power from a source to a target, both in practical and near future applications and in theoretical applications for the future. The limitations and potential safety concerns were also pointed out, and the mechanism of HR-WPT was described as an alternate method for WPT. WPT has the potential to completely disrupt the way that mobile devices, from cell phones and laptops to cars and aerial vehicles, operate and obtain energy. The future of energy is the untethering of devices from a power cord to realize the freedom of mobile technologies.

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