

Wi-Fi Electricity: Wireless Power Transmission Technology Changing Electrical Grid And Circuit



Engineering

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ABSTRACT

As the electrical power demand increases day by day, the power generation increases and the power losses is also increased. In our present electricity generation and transmission system we waste more than half of our resources.

Much of this power is wasted during transmission from power plant generators to the consumer. The resistance of the wire used in the electrical grid distribution system causes a loss of 26-30% of the energy generated. This loss implies that our present system of electrical distribution is only 70-74% efficient. We have to think of alternate state-of-art technology to transmit and distribute the electricity. Now-a-days global scenario has been changed a lot and there is tremendous development in every field. If we don't keep pace with the development of new power technology we have to face a decreasing trend in the development of power sector. The transmission of power without wires, wi-fi electricity or wireless power transmission is an intelligent technology to reduce transmission and distribution losses together with the complexity and cost of grid system. Also the wi-fi electricity technique helps to design solar roads (solaroads) and solar power satellites (SPS).

INTRODUCTION

The traditional power system requires a large grid network for transmission of electric power. Due to resistance of wires used in electrical network most of the power is wasted during transmission from generation end to consumer end. To meet the power loss challenge and complex electrical connection, wi-fi electricity gives an intelligent alternative technique for transmitting electric power. Wi-fi electricity is wireless power transmission technique for efficient transmission of electric power from power plants to the destination end consumers without the use of wire or any direct materialistic contact. WPT has been developed that could cut the clutter or lead to clean sources of electricity.

Although many prototypes have been developed so far but some of them are working well in various fields making power transmission very simpler. This can be used for applications where either an instantaneous amount or a continuous delivery of power is needed, but where conventional wires are unaffordable, inconvenient, expensive, hazardous, unwanted or impossible. The power can be transmitted using microwaves, millimeter waves or lasers. WPT is a technology that can transport power to locations, which are otherwise not possible or impractical to reach.

WPT TECHNOLOGY

Depending on the distance of consumer end and generation end of electric power the wireless power transmission technology uses different working concept. These techniques are briefly classified into three. These are: (a) Short range, (b) Medium range and (c) Long range.

Short range

The action of an electrical transformer is the simplest instance of wireless energy transfer for a few centimeter distances. The transfer of energy takes place by electromagnetic coupling through a process known as mutual induction. The electric toothbrush charger is an example of how this principle can be used. The Splashpower recharging mat and Edison Electric's Power desk both use coils to create a magnetic field. Electronic devices use corresponding built-in or plug-in receivers to recharge while resting on the mat. These receivers contain compatible coils and the circuitry necessary to deliver electricity to device's batteries.

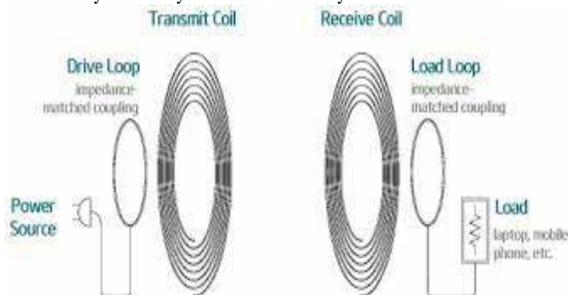


Figure 2: short range WPT

Source: www.gopixpic.com

Medium range

It uses Resonance just like in household devices, which produce relatively small magnetic fields and can induce current at small distance. A larger, stronger field could induce current from farther away, but the process would be extremely inefficient. Since a magnetic field spreads in all directions, making a larger one would waste a lot of energy. An efficient way to transfer power between coils separated by a few meters is that we could extend the distance between the coils by adding resonance concept. Induction can take place a little differently if the electromagnetic fields around the coils resonate at the same frequency. The theory uses a curved coil of wire called inductor and a capacitance plate, which can hold a charge, attaches to each end of the coil. As electricity travels through this coil, the coil begins to resonate. Electricity, traveling along an electromagnetic wave, can tunnel from one coil to the other as long as they both have the same resonant frequency. If a proper resonant waveguide is brought near the transmitter, the evanescent waves can allow the energy to tunnel. Similarly, if the two coils resonate at different frequencies, nothing will happen. But if two resonating coils with the same frequency get within a few meters of each other, streams of energy move from the transmitting coil to the receiving coil. So one coil can even send electricity to several receiving coils, as long as they all resonate at the same frequency. The researchers have named this non-radiative energy transfer since it involves stationary fields around the coils rather than fields that spread in all directions. So one coil can recharge any device that is in range, as long as the coils have the same resonant frequency. Electromagnetic induction works on the principle of a primary coil generating a predominantly magnetic field and a secondary coil being within that field so a current is induced within its coils. This causes the relatively short range due to the amount of power required to produce an electromagnetic field. Over greater distances the non-resonant induction method is inefficient and wastes much of the transmitted energy just to increase range. This is where the resonance comes in and helps efficiency dramatically by "tunneling" the magnetic field to a receiver coil that resonates at the same frequency. Unlike the multiple-layer secondary of a non-resonant transformer, such receiving coils are single layer solenoids with closely spaced capacitor plates on each end, which in combination allow the coil to be tuned to the transmitter frequency.

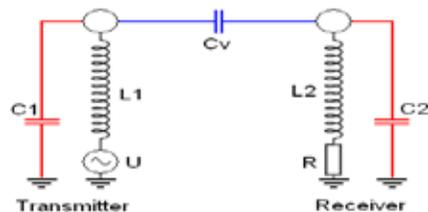


Figure 2 :medium range WPT

Source : markobakulawordpress.com

Long range

Resonance and induction generally sends power over relatively short distances. But some plans for wireless power involve moving electricity over a span of miles. A few proposals even involve sending power to the Earth from space. Power transmission via radio waves can be made more directional, allowing longer distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range. A large, disc-shaped rectifying antenna, or rectenna, changes the microwave energy from the transmitter into direct-current (DC) electricity. Rectenna conversion efficiencies exceeding 95% have been realized. Power beaming using microwaves has been proposed for the transmission of energy from orbiting solar power satellites to Earth and the beaming of power to spacecraft leaving in orbit. Rectifying antennae are central to many wireless power transmission theories. They are usually made of an array of dipole antennae, which have positive and negative poles. These antennae connect to shottkey diodes. Here's what happens: 1. Microwaves reach the dipole antennae. 2. The antennae collect the microwave energy and transmit it to the diodes. 3. The diodes act like rectifier and direct the electrons to the rectenna's circuitry. 4. The circuitry routes the electrons for electric power.

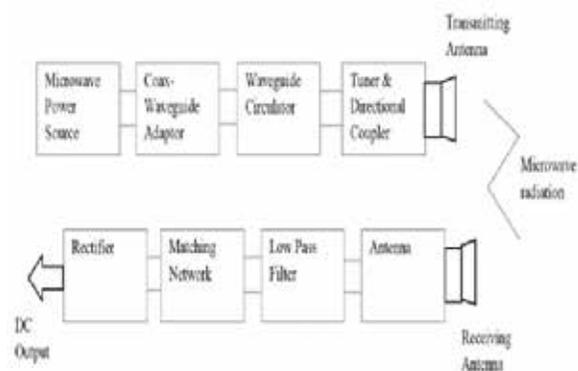


Figure 3: long range WPT
Source: www.csewustl.edu

SOME APPLICATIONS

Powering devices or vehicles from a remote power source is now working using WPT. The energy grid investment is reduced. Using long distance, highly efficient wireless power transmission we can reduce our reliance on transmission lines to transfer energy over long distances. Moreover, wireless power transfer could allow an alternative source of clean energy by transmitting solar power from space back down to places where it is needed without any wire connection. Applicable in chargeable vehicles, solar roads and solar satellites.

CHALLENGES

The system would reduce the cost of electrical energy used by the consumer and rid the landscape of wires, cables, and transmission towers. The electrical energy can be economically transmitted without wires to any terrestrial distance, so there will be no transmission and distribution losses. The efficiency of the transmission can be as high as 96 percent, and there are practically no losses. Calculating the circulating reactive power, it was found that the frequency is very small and such a frequency is very hazardous. So a little bit dangerous because they pose a potential environmental concern and biological hazards.

CONCLUSION

Now-a day the Wi-Fi electricity has a versatile application in various fields. The electrical energy can be economically transmitted without wires to any terrestrial distance. Many researchers have established in numerous observations, experiments and measurements, qualitative and quantitative. Dr.N.Tesla is the pioneer of this invention. Wireless transmission of electricity have tremendous merits like high transmission efficiency and low power loss (90 – 96 % efficient) and can be transmitted to anywhere in the globe and eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations. The system would reduce the cost of electrical energy used by the consumer and get rid of the landscape of wires, cables, and transmission towers. It has a tremendous economic impact to human society. Many countries are getting benefit from this service. Technology advancement gave major aspect of chargeable vehicles, solar power satellite and solar power roads, which will definitely change the electric power scenario changing automotive sector and power sector.

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