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| |  |  | | --- | --- | | U.S. Radiocommunications Sector  Fact Sheet | | | **Working Party:** ITU-R WP 1A | **Document No:** USWP1A23\_10\_rev2 – PDR Report SM.2392 for Beam WPT on ISM Frequencies | | **Ref:** Report on the first 2019-2023 meeting of Working Party 1A **–** [Annex 06](https://www.itu.int/dms_ties/itu-r/md/19/wp1a/c/R19-WP1A-C-0073!N06!MSW-E.docx) - Preliminary draft revision of Report ITU-R SM.2392-0 - Applications of wireless power transmission via radio frequency beam | **Date:** 8 April 2021 | | Document Title: Revision to “Preliminary draft revision of Report ITU-R SM.2392-0 - Applications of wireless power transmission via radio frequency beam” | | | **Author(s)/Contributors(s):**  Allen Yang FCC  Kevin Graf FCC | **Email**: Allen.Yang@fcc.gov **Phone**:  **Email**: Kevin.Graf@fcc.gov  **Phone**: | | **Purpose/Objective:** Proposal to improve clarity. | | | **Abstract:** The document uses a mix of potentially confusing terminology to distinguish between radiating (aka, over-the-air or at-a-distance) and non-radiating (aka, inductive/capacitive, directly coupled, or locally operated) WPT. The phrase “contact-based” appears to be used to mean physical contact but could potentially be confused with electrical contact. A list of terms to be used consistently may be helpful. Stylistic improvements may be needed. Substantive edits were tentatively agreed at the second meeting. Those were regards to updating outdated sections. These are highlighted in yellow. Beyond scope of original fact sheet are highlighted in yellow to address comments on the document. These are also highlighted in yellow. | | |

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| United States of America  Proposed Revisions To Preliminary DRaft Revision of Report ITU-R SM.2392-0 |
| Applications of wireless power transmission via radio frequency beam |

Background

At the November-December 2020 meeting of Working Party 1A, this meeting revised and agreed to elevate the working document on Report ITU-R SM.2392-0 to a preliminary draft revision.

The May/June meeting is expected to consider received contributions and finalize the revision. Upon review, the US has noted that some terminology present in this revision is understood in context only to the regular participants in the work. A broader audience may not understand the usage of terminology. Therefore terminology should be clarified so that usage in this context is not confused with usage in other documents.

Proposal

The United States proposes to add editorially modify the document to remove ambiguity with respect to the usage of terms. The situation of the US is also updated. Only the sections with modifications are presented.

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| **Radiocommunication Study Groups** |  |
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| Source: Document 1A/TEMP/12(Rev.1) (edited) | **Annex 6 to Document 1A/73-E** |
| **14 December 2020** |
| **English only** |
| Annex 6 to Working Party 1A Chairman's Report | |
| Preliminary draft Revision of REPORT ITU-R SM.2392-0 | |
| Applications of wireless power transmission via radio frequency beam | |

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# 1 Introduction

Wireless power transmission (or transfer) (WPT) technology is considered as one of game changing technologies. We will be able to become free from lacking electric power when electric power will be supplied wirelessly. Power transmission by radio waves dates back to the early work of Nikola Tesla in 1899. Tesla carried out his first attempt to transmit power without wires in 1899. He used low frequency power of 150 kHz, but his attempts failed. Parallel to Tesla’s first WPT experiments, M. Hutin and M. Le-Blanc proposed an apparatus and method for powering an electrical vehicle (EV) inductively in 1894 using an approximately 3-kHz AC generator [HUT 94]. EVs were developed during the period of time shortly after the steam engine, approximately one hundred years ago. Both inductive WPT, which is a type of ‘non-beam’ WPT, and the WPT via radio frequency beam, which is called ‘beam’ WPT, were started in the early 20th century.

The present development of the WPT via radio frequency beam owes to William Brown in 1960s using microwave technology developed during the World War II. He transmitted the microwave power from a transmitter to a receiver (point-to-point) with the overall (DC-microwave-DC) efficiency of 54% in his laboratory [BRO73]. When we use the microwave frequency, the WPT via microwave is called a microwave power transmission (MPT). A lot of the inductive WPT research projects for a wireless charging of EVs were carried out in 1980s and 1990s [SHI 14]. Commercial products of contactless cables are produced after 1900s. A turning point of the inductive WPT was in 2006, when Massachusetts Institute of Technology (MIT) demonstrated non-beam wireless power technology called resonance coupling WPT [KUR 07]. Nowadays, resonant WPT technologies are coming out to consumer market. Automotive industry looks at WPT for EV applications in near future. Information about WPT using technologies other than radio frequency beam, as partial answers to the Question ITU-R 210-3/1 was published as Report ITU-R SM.2303 in 2014. After the MIT’s demonstration, a variety of WPT technologies including magnetic induction, resonance coupling, transmission via radio frequency beam, etc. are paid attention as game changing technologies.

This Report provides information about WPT applications using radio frequency beam. The ITU Radio Assembly considers that wireless power transmission (WPT) is defined as the transmission of power from a power source to an electrical load wirelessly using the electromagnetic field. The ITU Radio Assembly also considers that that WPT technologies utilize various mechanisms, such as transmission via radio frequency radiated transmissions in the far field (WPT beams) and near-field inductive, resonant and capacitive coupling (WPT non-beam) . WPT beams do not specify between directed or non-directed electromagnetic waves. Also, some antenna configurations will allow the mechanism of radiated transmission for power without regard for distance. In these cases, the use of the terms near-field and far-field are not needed. This document covers beam WPT as well as power transmission by non-directed, radiated electromagnetic waves, which can include non-beam applications such as energy harvesting. This document does not cover WPT technologies that do not use radiated electromagnetic waves to transfer power, such as magnetic induction, magnetic resonance, and capacitive coupling technologies. Those technologies are covered in the Report ITU-R SM.2303.

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# 2 Applications developed for use of WPT technologies via radio frequency beam

Major characteristics of the WPT via radio frequency beam are: 1) intention for radiated transmissions without regard for distance, 2) no intention for inductive, resonant or capacitive coupling , and 3) various applications, e.g. weak powered sensors, high power wireless chargers, huge power transfer from power station, etc.

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## 2.2 Wireless charging of mobile/portable devices

Wireless charging technologies have been in constant evolution, currently offering support for radiated transmissions without regard for distance (beam WPT). Beam WPT, which produces radiated transmissions without regard for distance technology can offer substantial improvements in some applications as compared to non-beam WPT, which utilizes inductive, resonant and capacitive coupling technologies.

Beam WPT technology can be designed and implemented into many different sized electronic devices for the home and office, as well as the medical, industrial, retail and automotive industries, and it ensures interoperability across products. These devices include wearables, hearing aids, earbuds, Bluetooth headsets, Internet of Things (IoT) devices, smartphones, tablets, e-book readers, keyboards, mice, remote controls, rechargeable lights, cylindrical batteries, medical devices and any other device with similar charging requirements that would otherwise need a battery or a connection to a power outlet.

Beam WPT transmitters use narrowband spectrum, typically 400 kHz or less, to transmit RF energy to its client device. The transmitter is inactive until an authorized client device has been identified, authenticated, and determined to be at zero distance from the WPT charger pad. Beam WPT over-the-air technology operate in similar spectrum, and rely on antenna arrays and beam focusing techniques to transmit RF energy to precise client device locations. Because some beam WPT power transmissions are directed to a client device, they should not be viewed as an isotropic radiator, as they focus their energy on specific locations and transmit only when an authorized client is present.

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### 2.2.2 Situation of U.S.

Several U.S. companies have developed beam WPT technology similar in purpose to use cases of radiated transmissions without regard for distance technology.. U.S. based company Ossia in 2020 demonstrated a digital shelf labeling system for retailers that requires no wires or batteries. Its technology operates at 2.4 and 5.8 GHz. It has an operating range of up to about 30 feet and can also power smartphones, compatible smart home devices, automotive sensors and many other devices. Other U.S. companies have technologies that operate at different frequencies. GuRu uses mm wave frequencies, similar to those used for 5G wireless communications. [FOW 20] And Energous has demonstrated its WattUp technology, which operates in the 900 MHz frequency band. [DAV 18].

[FOW 20] Fowler, Ben, Consumer Reports. <https://www.consumerreports.org/emerging-technology/wireless-charging-the-next-leap-wireless-power/>

[DAV 18] Davies, Alex, ReThink, https://rethinkresearch.biz/articles/ces-ossia-energous-unleash-rival-long-range-wireless-charging-specs/

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