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| Hilversum, The Netherlands, 27th - 30th November 2018 |
| 6th meeting of CPG Project team D |  |
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| Subject:  | Draft CEPT Brief on WRC-19 Agenda item 9.1, Issue 9.1.6 |
| 6th meeting of CPG Project team D |  |
| Summary:  |
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| Proposal: |
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1. The following pages are intended to be compiled in one CEPT Brief on AI 9

DRAFT CEPT BRIEF ON AGENDA ITEM 9.1 – Issue 9.1.6 – ResolutioN 958 (WRC-15)

Resolution 958 (WRC-15) - Urgent studies required in preparation for WRC-19 - Studies concerning Wireless Power Transmission for electric vehicles

# ISSUE

Resolution 958 (WRC-15) calls to complete ITU-R studies concerning Wireless Power Transmission (WPT) for electric vehicles (EV):

* 1. to assess the impact of WPT for electric vehicles on radiocommunication services;
	2. to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.

# Preliminary CEPT position

CEPT is of the view that no regulatory action to the RR will be required in order to resolve AI 9.1, issue 9.1.6. ITU-R Report SM.[WPT.SPEC.MNGM] and Recommendations ITU-R SM.2110 and ITU-R SM.[WPT-UNWANTED], are considered sufficient to specify suitable frequency bands and limits on unwanted emissions for WPT-EV, along with determination of the related centre frequencies.

CEPT has identified the following candidate bands as suitable for WPT-EV, which can minimise the impact of WPT-EV on radiocommunication services:

19-21 kHz for the highest power category (specific heavy-duty electric vehicles), and

79-90 kHz for the medium power category (all types of electric vehicles).

In addition, CEPT is of the view that no bands above 90 kHz should be considered for use by WPT-EV.

CEPT is of the view that bands at 60 kHz and 77.5 kHz used by applications of the standard frequency and time signal service are not suitable for WPT-EV and require specific protection.

# Background

WPT technologies are being developed to support the easy and fast transfer of power wirelessly. WPT-EV is becoming an important charging technology, aiming at the reduction of the vehicle’s battery size and consequently improving its practical driving distance in order to facilitate the deployment electric mobility. ITU-R Recommendation SM.2110 addresses WPT technologies in general, currently containing only one band for mobile/portable device charging. Due to the necessary power and capacities of the batteries, low power WPT will not be applicable for WPT-EV charging purposes. There are currently activities outside CEPT underway in the ITU-R to add new frequency ranges to ITU-R Recommendation SM.2110 to cover WPT-EV.

Several frequencies have been under consideration within CEPT for WPT-EV applications namely: 19-21 kHz; 59-61 kHz and 79-90 kHz. Of these bands 19-21 kHz and 79-90 kHz have been studied in CEPT[[1]](#footnote-1).

It needs to be noted that WPT-EV requires far higher power levels than for general WPT applications dedicated to charge batteries of user equipment (e.g. watches or mobile devices). Therefore concerns were raised at WRC-15 that WPT-EV may cause harmful interference to radiocommunication services depending on the frequency band used.

Whilst WPT is not defined as a radiocommunication service, for the purpose of the work on this issue it is treated as a radio application. The preferred frequencies for WPT-EV are generally relatively low. In such circumstances, any WPT-EV application shall not cause harmful interference to radiocommunication services. ETSI developed a harmonised standard (EN 303 417) for “Wireless power transmission using technologies other than radio frequency beam in 19-21 kHz; 59-61 kHz; 79-90 kHz; 100-300 kHz; 6 765-6 795 kHz”. However, this harmonised standard is not only covering WPT-EV. It covers all kinds of WPT applications.

CEPT supports a methodology and guidelines to Administrations to specify the appropriate bands with associated power and unwanted emission limits to minimise the impact to the radiocommunication services. Any resulting ITU-R Report(s) and/or Recommendation(s) regarding WPT-EV should include clear information that ensures the protection of radiocommunication services from both in-band as well as unwanted emissions.

# List of relevant documents

ITU-R

* Report ITU-R SM.2303-1, Wireless power transmission using technologies other than radio frequency beam
* ITU-R Resolution 705 (Rev.WRC-15), Mutual protection of radio services operating in the frequency band 70-130 kHz
* Annex 4 to Document 1B/260 Working document towards a preliminary draft revision on Recommendation ITU-R SM.2110-0 Frequency ranges for operation of non-beam wireless
power transmission systems
1. This reference should be updated
* Working Document towards a preliminary draft new Report ITU-R SM.[WPT.SPEC.MNGM]; Methodology for spectrum management of wireless power transmission (WPT) .
* ITU-R Question 210/3-1 [‘Wireless power transmission’](http://www.itu.int/pub/R-QUE-SG01.210)

CEPT and/or ECC Documentation (Decisions, Recommendations, Reports)

* Draft ECC Report on Work Item SE24\_60 (Wireless Power Transmission (WPT) systems for electrical vehicles (EV) operating within 79 - 90 kHz band)

EU Documentation (Directives, Decisions, Recommendations, other), if applicable

ETSI Documentation

* ETSI TR 103 409, System Reference document (SRdoc); Wireless Power Transmission (WPT) systems for Electric Vehicles (EV) operating in the frequency band 79-90 kHz
* ETSI EN 303 417, Wireless power transmission using technologies other than radio frequency beam in the 19-21 kHz, 59-61 kHz, 79-90 kHz, 100-300 kHz, 6 765-6 795 kHz ranges

# Actions to be taken

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations

APT (March 2018)

Preliminary View

APT Members support the studies carried out by ITU-R in accordance with Resolution 958 (WRC‑15) to assess the impacts of WPT for electric vehicles on radiocommunication services and to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electric vehicles (EVs).

APT Members are of the view that all radiocommunication services must be adequately protected from harmful interference that may be generated by WPT for EVs, both at the fundamental frequency and from spurious and out-of-band emissions.

APT Members support consideration of the inclusion of one or more frequency ranges for WPT for EVs in an ITU-R Recommendation based on completion of ITU-R studies.

Other views:

Some APT Members proposed to add the word “unacceptable” before the word “constraints” in the last line of the APT Preliminary View(s).

ATU (September 2017)

The APM19-2 agreed to:

* Support the ongoing sharing and compatibility studies between Wireless Power Transfer (WPT) systems and existing services.
* Note that the 85kHz band is the preferred band with high probability of harmonisation and is the least likely to cause interference to other services.
* Urge administrations to contribute to and actively participate in the ongoing studies to ensure that existing services are protected from spurious and out of band emissions from WPT applications, and to positively influence the outcome of the studies.
* Note the ICAO concern regarding the impact modulation on aviation systems.
* Note that WP 1B Report ITU-R SM.2303 contains the potential impact/effects of radiation from WPT systems and invited administrations to consider the information.

Arab Group (ASMG) (April 2018)

* Support the current studies to assess the impact of (WPT) for electric vehicles on radiocommunication services; and to study suitable frequency ranges which would minimize the impact on radiocommunication services from(WPT) for electric vehicles.
* Ensure the protection of the incumbent services and not add any additional constraints on these services.
* Emphasize the importance of universally harmonized frequency bands to achieve a global standardization.

CITEL (TBD)

RCC (March 2018)

The RCC Administrations are in favour of harmonizing frequency bands to be used for Wireless Power Transmission (WPT) for electric vehicles, which could be implemented by the development of relevant Recommendation ITU-R.

The RCC Administrations support the development of conditions for use of the frequency bands 19‑21 kHz, 59‑61 kHz, 79‑90 kHz and 100‑300 kHz by WPT devices, which would provide protection to stations of radiocommunication services from possible interference, and which have relevant allocations in the Radio Regulations on a primary or secondary basis.

## International organisations

NATO (June 2018)

NATO Military Assessment

As candidate frequency bands or individual frequencies for WPT applications are 19-21 kHz, 59-61 kHz, 79-90 kHz and 100-300 kHz under discussion.

The range 14-148.5 KHz is a NATO harmonised band and essential to NATO and is in military use for naval communications and tactical non-directional beacons.

From a military perspective, studies will need to show compatibility with applications of the existing services and that the introduction of WPT systems for electric vehicles has no harmful impact on military usage.

NATO position:

No NATO Position at this stage, however NATO Nations are actively monitoring this issue to assess the potential impact on NATO military usage.

IATA (date of proposal)

ICAO (12 September 2017)

To ensure that the protection of aeronautical systems is appropriately taken into account during the studies called for in response to Resolution 958 (WRC-15).

IMO (date of proposal)

IARU (June 2018)

IARU observes that the High Power Wireless Power Transfer (HPWPT) is an emerging technology which will in time become deployed on a widespread basis (one in every house). IARU further observes the on-going work in ITU and standards organisations to propose frequency ranges for HPWPT. IARU is of the view that radio frequency emissions resulting from any kind of Wireless Power Transmission (WPT) must be confined to the frequency ranges already identified for equipment used for industrial, scientific, and medical (ISM) applications or if found necessary, to frequencies below 100 kHz.

Since HPWPT involves very large amounts of RF power and an HPWPT installation involve components connected together in a system with associated power supplies and control equipment, the spurious emissions from all these system parts must be carefully controlled in order to avoid degrading the radio spectrum and cause interference to other radiocommunication systems or services in accordance with RR 15.12 and RR 15.13.

Sources of emissions on frequencies other than the fundamental frequency of the HPWPT include:

* High order harmonics of the fundamental WPT frequency;
* Phase noise from the frequency control circuits (“jitter”) causing wideband noise;
* Spurious signals from the switch-mode power supply on all control and power ports – conducted and common mode;
* Common mode signals on control cables and power lines from data communication networks associated with the control of the unit;
* To ensure adequate protection to authorised radio services, proper compatibility and sharing studies have been conducted which confirm that harmful interference to LF, MF and HF radiocommunication services in the domestic environment is inevitable unless spurious emission limits are revised to provide greater protection than at present.

IARU regards cooperation between ITU and Standards organisations to be essential in the evolution of standards and frequencies for HPWPT operation.

Studies by IARU and others show that the level of emissions in the spurious domain envisaged in ITU-R SM.329 or ERC Rec 74-01 do not protect radio services from harmful interference when WPT installations are nearby. The emissions exceed by some 40dB+ the level which would provide proper protection. Some degree of mitigation is possible if all WPT installations were to operate on a tightly specified and stable single frequency with good wideband noise performance.

No WPT system operating at c 85 kHz has been available for evaluation. The modelling that has been done, therefore, has been based on existing limits and standards. A number of factors remain uncertain, including;

* 1. The likely spurious emission levels from WPT(EV) systems, ITU-R SM329-12 has therefore been take as the basis for study as WPT manufacturers have stated in SE24 that this is their target performance level.
	2. The likely frequency tolerance. The ITU-R PDNR on WPT for electric vehicles states that system retuning of +/- 0.5 kHz is likely. This results in a potential impact across 50% of the radio spectrum around 4 MHz and correspondingly greater percentages at higher frequencies.

ETSI Standard EN 300330 and related modelling allows a realistic assessment to be made of the extent of emissions around a WPT system which meets the requirements of ITU-R SM329-12 in respect of spurious emissions at all frequencies. This shows that WPT systems will raise the rural noise level at distances of up to 1 km from the installation. By any measure this constitutes widespread harmful interference. Recognising the requirements of RR 15.12 and 15.13, appropriate limits for emissions in the spurious domain should be developed as part of the introduction of WPT for EV in the domestic residential and rural environment. Without tighter limits, the coexistence of broadcast and amateur services in the LF, MF and HF spectrum with WPT(EV) is open to question.

SFCG (August 2018)

While past work on the topic of WPT for electric vehicles has focused on bands below 400 kHz, and in the 6 765-6 795 kHz band, Resolution 958 (WRC-15) does not limit the studies to those bands. SFCG should continue to monitor the developments of this issue for any spectrum requirements identified that could impact space science services operations.

WMO and EUMETNET (June 2018)

Resolution 958 (WRC-15) calls to complete ITU-R studies concerning Wireless Power Transmission (WPT) for electric vehicles to assess the impact of WPT for electric vehicles on radiocommunication services and to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.

The frequency range initially mentioned under this Agenda Item is 20 to 6800 kHz. If this frequency range is confirmed, details on WPT principles and related propagation conditions will be needed to assess the potential impact of WPT on lightning detection networks and oceanographic radars deployed by the meteorological community.

WMO will monitor this AI to ensure that any possible change will not adversely impact any service used for meteorological operations.

## Regional organisations

ESA (28 November 2016)

ESA supports the SFCG position.

Eurocontrol (date of proposal)

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (24 September 2018)

EBU members operate amplitude modulation broadcasting stations in the LF, MF and HF bands. Information on actual LF and MF broadcasting transmitters operated in Region 1 has been provided by EBU to CEPT through SE24.

Studies show the possibility of interference to the reception of those stations from harmonic emissions of WPT equipment used for electric vehicle charging. Studies also show that the required limits based on protection requirements of AM broadcasting signals are significantly more stringent than current limits specified for inductive devices in CEPT, ETSI or CISPR. Where necessary attention should be drawn to these differences and the reasons for them. The EBU has proposed a mitigation technique in the relevant working groups of these organisations. This technique allows for a significant relaxation of the limits by the selection of particular WPT frequencies with enhanced stability.

Any use of WPT devices therefore needs to be sufficiently regulated in order to limit emissions to levels which will not cause harmful interference to the broadcasting service. The EBU is strongly of the view that as well as specifying frequency bands for WPT operation it is essential that tolerable limits, below which harmful interference is unlikely to occur, should be specified and clearly disseminated through Reports and Recommendations in the CEPT, ETSI, CISPR and the ITU for all affected radiocommunication services.

GSMA (date of proposal)

CRAF (date of proposal)

1. Measurement reports of real WPT-EV systems operating in these bands have been analysed by WG SE and SE24. [↑](#footnote-ref-1)