



Global Status on WPT Standardization and Regulation

Kaz Ishida

Chairman of the Standards Development Group,
Broadband Wireless Forum WPT-Working Group

Director, Technical Standards
QUALCOMM (Japan)

March 2017, TAICS WPT Seminar

CONTENTS

- ITU-R Structure for WPT Studies
- Recommendation Development
- WPT for Electric Vehicles as an Urgent Study Item towards WRC-19
- Global Wireless EV Charging Standardization Activities
- CISPR WPT Activities
- Closing
- Appendix

References

This material mainly refers to the following documents.

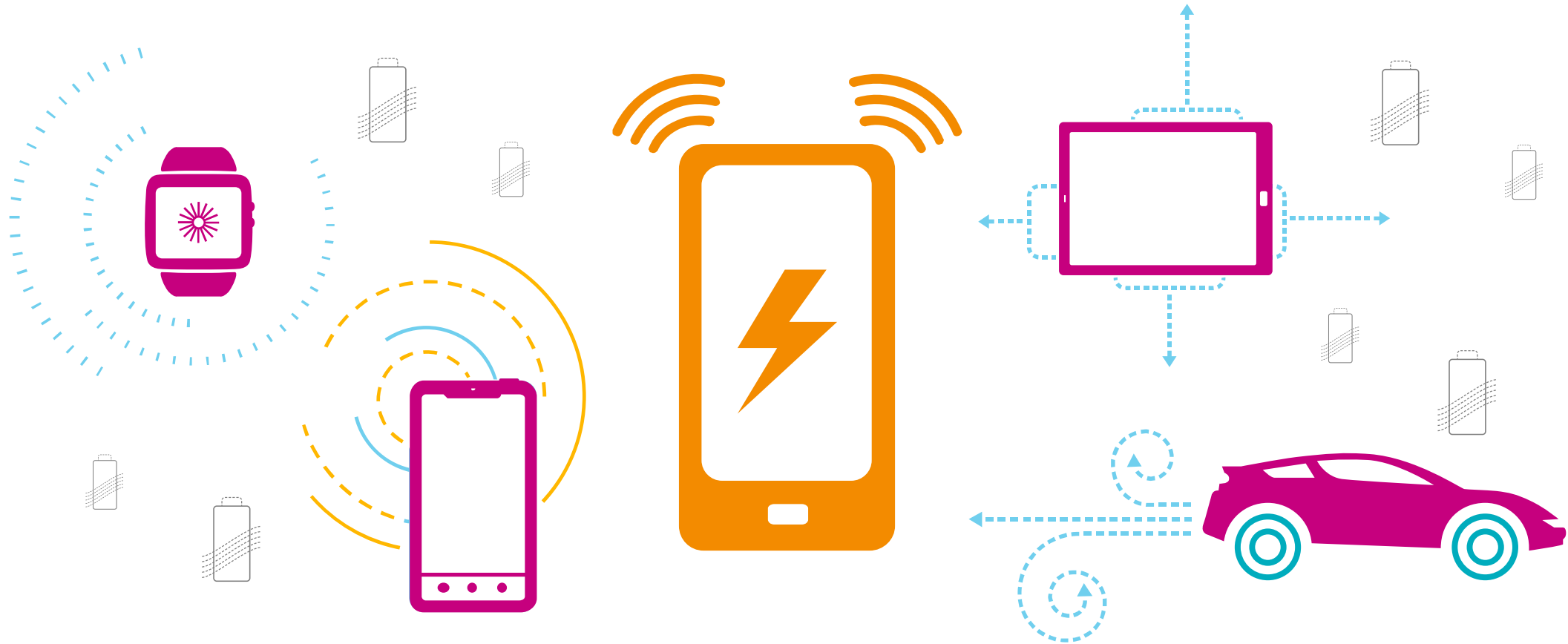
- ITU-R Annex 5 to Doc 1A/144, 12 Dec 2016 (Draft New Recommendation “Frequency ranges for operation of non-beam Wireless Power Transmission (WPT) systems on WPT frequency ranges”, work in progress)
- ITU-R Annex 6 to Doc 1A/144, 13 Dec 2016 (Draft Revision of Report ITU-R SM.2303-1 “Wireless power transmission using technologies other than radio frequency beam”, work in progress)

“ITU-R Structure for WPT Studies



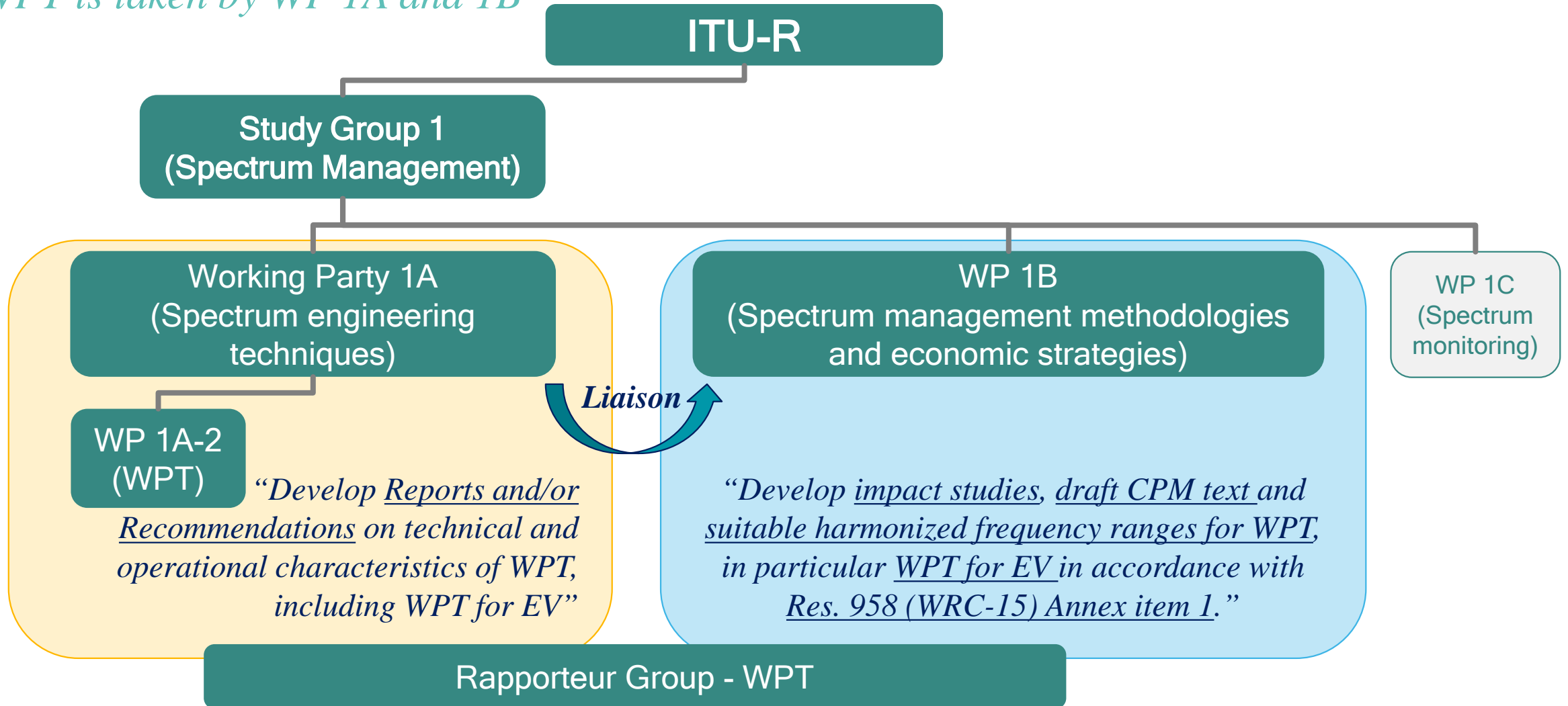
WPT Definition in ITU-R SG1 WP 1A

In ITU-R terminology, wireless power transmission (WPT) is defined as the transmission of power from a power source to an electrical load using electromagnetic field



ITU-R WPT Study Structure

WPT is taken by WP 1A and 1B



“Recommendation Development



Technologies and applications

Non-beam WPT via inductive/resonant for mobile and EVs is the current focal point.

- Technologies include transmission via
 - ❖ Inductive,
 - ❖ Resonant,
 - ❖ Capacitive coupling, and
 - ❖ Radio frequency beams

- Applications include:
 - ❖ Mobile devices,
 - ❖ Home appliances,
 - ❖ Electric tools, and
 - ❖ Electric vehicles (passenger vehicles, busses, trucks, automated guided vehicles (AGV)).



Frequency ranges under study in WP 1A and 1B

Some administrations already authorized use of some of these bands for WPT technologies

- Standards are currently being developed at national, regional, and international levels for wireless charging of mobile devices and electric vehicles, etc.
- Frequency ranges for WPT technologies proposed at WP 1A for harmonization include:

Frequency range	Suitable WPT technologies and applications
19-21 kHz and 59-61 kHz	Shaped magnetic field in resonance Electric Vehicles (Busses and trucks)
79-90 kHz	Magnetic resonant technology for Electric Vehicles
100-300 kHz	Magnetic resonant and induction technology for mobile devices
6,765-6,795 kHz	Magnetic resonant technology for mobile devices

Study on the impact of WPT to radiocommunication services

WP 1A and 1B ask for study results on proposed frequency ranges.

- As the number of WPT devices is growing, the use of WPT technologies may have an impact on the operation of radiocommunication services including the standard frequency and time signal service and the radio astronomy service.
- Radiation outside the bands used by WPT should be minimized in order to preserve the RF spectrum of radiocommunication services.
- To mitigate the impact of WPT devices on the operation of radiocommunication services some solutions utilize ISM bands.
- **Japan concluded studies on the impact of WPT** to radiocommunication services in the bands **79-90 kHz for EVs (3.3 kW and 7kW classes)** and **6,765-6,795 kHz for mobile devices (< 100W).** See Report ITU-R SM.2303-1 for details.
- Korea undertook studies on the impact of WPT in the band 110-300 kHz.

Human exposure to non-ionizing radiation

Globally accepted guidelines on RF exposure will be referenced in Recommendation.

- Issues of non-ionizing radiation exposure are dealt with by international organizations such as:
 - The World Health Organization (WHO),
 - The International Commission on Non ionizing Radiation Protection (ICNIRP), and
 - International Electrotechnical Commission TC106,
- ICNIRP 2010 provides guidelines for limiting exposure (up to 10 MHz)
- ICNIRP 1998 provides Guidelines for limiting exposure (up to 300 GHz).

Current status of Recommendation development

Listed 6,765-6,795 kHz only. WP 1A to approve in June 2017 unless critical issue comes out.

- Recommendation ITU-R SM.[WPT] “Frequency ranges for operation of non-beam Wireless Power Transmission (WPT) systems”
- 6,765-6,795 kHz in the list.
- Resonant technology
- For mobile devices
- Supports from many countries
- No defects found
- ISM band with RR 5.138 provision (a)
- In June 2016, Draft New Recommendation was not agreed at WP 1A.
 - ❖ Germany, UK, and Netherlands objected:
 - SDOs not completed work.
 - Only one frequency band listed
 - Not require a specific recommendation
 - Economic and commercial implications of recommending only one band.
- If necessary, other bands may be proposed with the impact study results and agreement from concerned Working Parties.

a) *“The use of these frequency bands for ISM applications shall be subject to special authorization by the administration concerned, in agreement with other administrations whose radiocommunication services might be affected. In applying this provision, administrations shall have due regard to the latest relevant ITU-R Recommendations”*

“WPT for Electric Vehicles as an
Urgent Study Item towards WRC-19

WPT for EVs under WRC-19 Agenda Item 9.1, Issue 6

WP 1B takes studies to report to Director of the Radiocommunication Bureau.

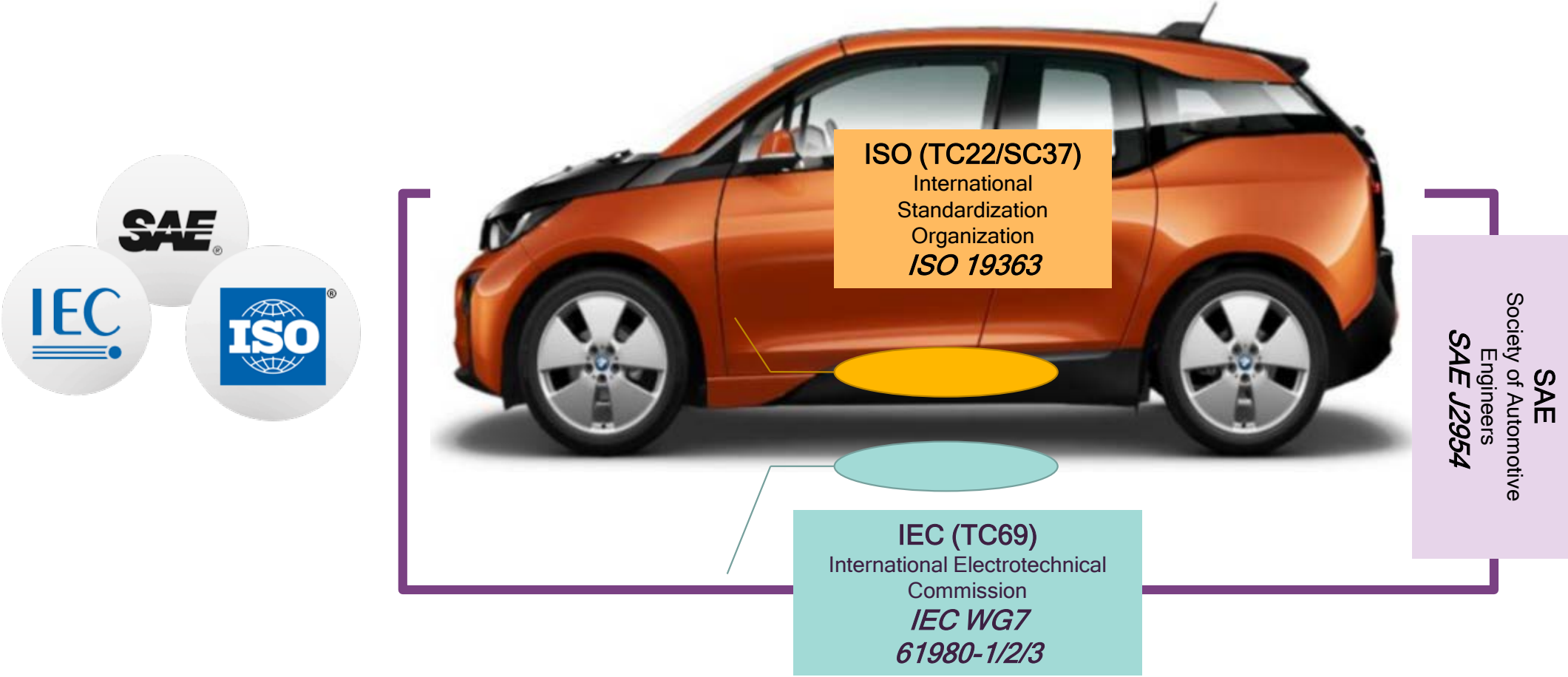
WRC-19 Agenda Item	Draft CPM Report to WRC-19			
	Section	Agenda item / Issue	References	Responsible Group
<u>9.1</u> <u>(issue 9.1.6)</u> <u>Urgent studies required in preparation for WRC-19</u>	6/9.1.6	1) Studies concerning <u>Wireless Power Transmission (WPT) for electric vehicles:</u>	Issue1 in the Annex to <u>Resolution 958</u> [COM6/15] (WRC-15)	<u>WP 1B</u>
		a) <u>to assess the impact</u> of WPT for electric vehicles on radiocommunication services;		
		b) <u>to study suitable harmonized frequency ranges</u> which would <u>minimize the impact</u> on radiocommunication services from WPT for electrical vehicles.		
		These studies should take into account that the International Electrotechnical Commission (<u>IEC</u>), the International Organization for Standardization (<u>ISO</u>) and the Society of Automotive Engineers (<u>SAE</u>) are <u>in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.</u>		

“Global Wireless EV Charging Standardization Activities



Worldwide Wireless EV Charging Standardization Committees

ISO/19363, IEC/61980, and SAE J2954 are in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.



IEC 61980 (IEC TC 69 / WG7)

IEC 61980 takes on the road-side while synching with ISO 19363.

- IEC TC 69 (Electric road vehicles and electric industrial trucks) WG7, together with ISO TC22 (Road Vehicles), discusses WPT for a vehicle.
 - IEC 61980-1: General Requirements (Published in July, 2015)
 - **IEC 61980-2: Communication** (Under development)
 - **IEC 61980-3: Magnetic Field Power Transfer** (Under development)
- 85 kHz band (**81.38-90 kHz**) will be specified as the system frequency for passenger cars and light duty vehicles in IEC 61980-3.
- Publications of **TSs (Technical Specifications)** of the IEC 61980-3 and IEC 61980-2 as well as Edition 2 of IEC 61980-1, are planned to be by **the end of 2017**.

ISO 19363 (ISO (TC22/SC37))

ISO 19363 takes on the vehicle-side interoperability.

- ISO 19363: Magnetic field wireless power transfer - Safety and interoperability requirements
 - The SC37 was established in early 2014
 - Target is to develop a standard which specifies requirements for the **vehicle-side** parts
 - **A close synchronization with IEC 61980 and SAE J2954**
- 85 kHz band (**81.38 - 90 kHz**) is specified as the system frequency for passenger cars and light duty vehicles.
- Publication of a PAS (Publicly Available Specification) is planned to be by the end of 2016, followed by the upgrading to IS (International Standard) by **the end of 2018**.

SAE (Society of Automotive Engineers)

Agreed on 81.38-90 kHz in Nov. 2013; Intended power classes of 3.7, 7.7, 11.1, and 22kW.

- The SAE International J2954™ Task Force for Wireless Power Transfer for Electric and Plug-in electric vehicles was established in 2010.
- The SAE International published “SAE TIR J2954 Wireless Power Transfer for Light-Duty Plug-In/ Electric Vehicles and Alignment Methodology” in May 2016, which establishes 85 kHz band (81.38 - 90 kHz) as a common frequency band for wireless power transfer for all light duty vehicle systems up to 22kW. The TIR (Technical Information Report) specifies two power classes (3.7 kW and 7.7 kW). Two more classes of higher power levels up to 22 kW are given for future revisions.
- SAE International is a global association uniting over 128,000 engineers and technical experts in the aerospace, automotive and commercial-vehicle industries.
- See <http://www.sae.org/news/3415/> and http://standards.sae.org/j2954_201605/.

ETSI TC ERM

Independent WPT standard development work from SRD in progress.

- ETSI TC ERM has recently published a **technical report (TR 103 409)** titled “System reference document (SRdoc); “Wireless Power Transmission (**WPT**) systems for Electric Vehicles (**EV**) operating in the frequency band **79-90 kHz**”. This SRdoc must now be considered by CEPT who will consider WPT-EV systems and look at co-existence with radiocommunication systems.
- ETSI TC ERM has recently approved a final draft version of **a new Harmonized Standard (EN 303 417)** for the ETSI EN approval procedure (ENAP), which is supposed to **specifically treat requirements for WPT systems** (instead of EN 300 330 - Non-specific short range devices, which was used for WPT systems in the past, but is not applicable anymore to WPT systems as of the latest revision). EN 303 417 will now undergo further scrutiny and possible changes, **Publication of the document is forecast for July 2017**. Creation of EN 303 417 has triggered drafting of a new systems reference document (TR 103 493) which in time will also be considered by CEPT.

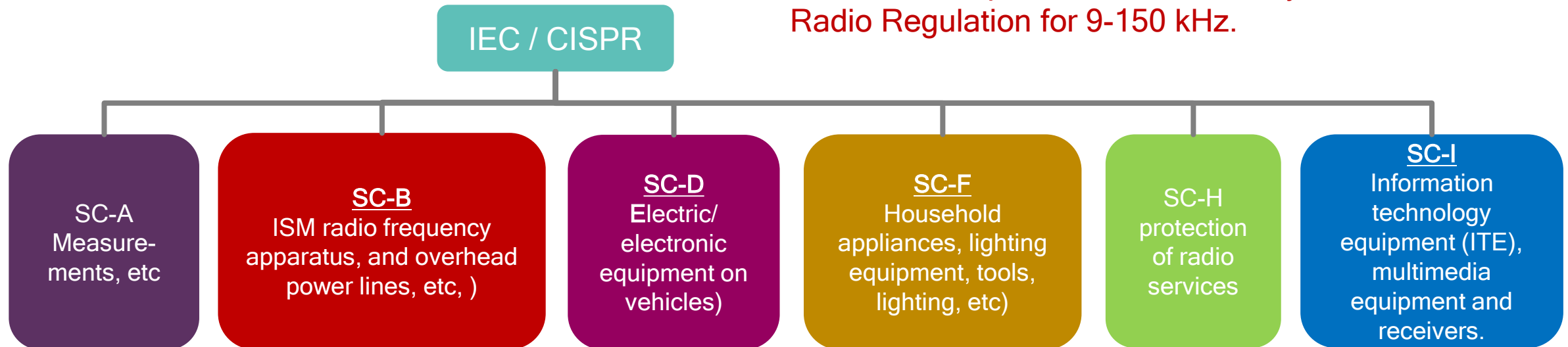
“CISPR WPT Activities



IEC / CISPR (Comité International Spécial des Perturbations Radioélectriques)

CISPR is in the process of approving emission limits of WPT including below 150 kHz.

- **CISPR SC-B takes WPT.**
 - ❖ SC-D, F, and I are also considering.
- **SC-B AHG4** intended for specification development.
 - ❖ Amendment to CISPR 11 for including the **emission requirements in 9 -150 kHz for power electronic WPT including EV**
 - ❖ Expecting publishing by not later than 2019.
 - ❖ CISPR 11 scope is for ISM, currently no ISM band in the Radio Regulation for 9-150 kHz.



CISPR candidate frequency bands for WPT below 150 kHz

79 – 90 kHz is intended for global harmonization but ITU-R takes frequency ranges.

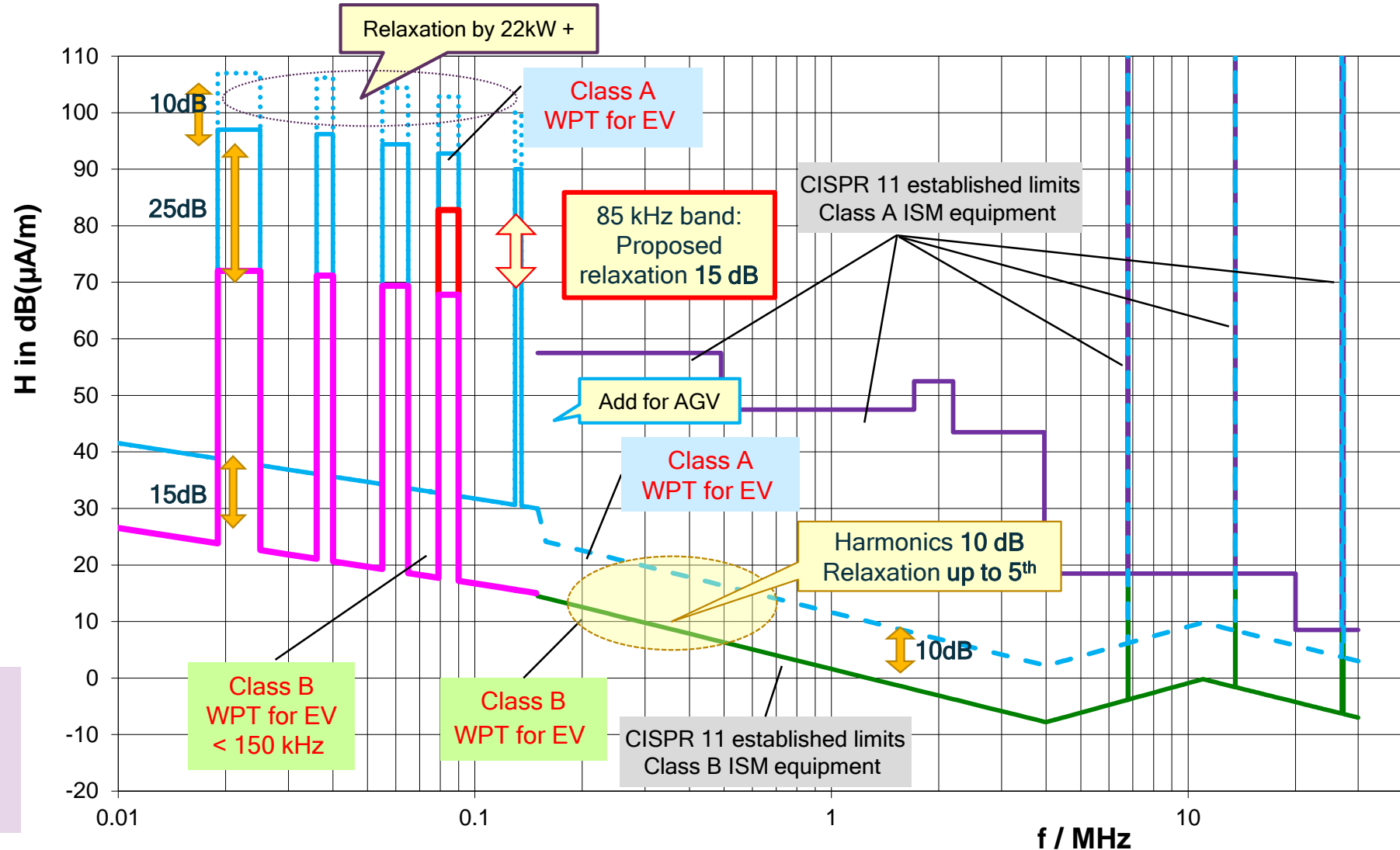
Frequency range (kHz)	Typical WPT use
19 to 25	Local WPT via an air gap in cm range, throughput power up to 200 kW – automated in-plant transportation systems, trams and electric buses
36 to 40	Local WPT via an air gap in cm range, throughput power up to 200 kW – automated in-plant transportation systems, trams and electric buses
55 to 65 (a)	Local WPT via an air gap in cm range, throughput power up to 200 kW – automated in-plant transportation systems, trams and electric buses
79 to 90 (b)	Local WPT via an air gap in cm range, throughput power in the range up to 22 kW – electric personal passenger vehicles (e.g. automobile) , automated in-plant transportation systems
130 to 135	Local WPT via an air gap in cm range, throughput power up to 200 kW – automated in-plant transportation systems, trams and electric buses

(a) It should be noted that 60 kHz is being used as a standard frequency and time signal service.

(b) CISPR Candidate WPT frequency range for global harmonization. The frequency range of 79 kHz to 90 kHz is being considered for Electric Vehicles.

CISPR/B Emission Limits for May meeting

85 kHz band relaxation is a primary subject.



Ref:
 CIS/B/678/CD,
 CIS/B/673/DC,
 BWF WPT-WG SWG-
 EMC Doc 19-04

—
“Closing



Summary

- 6.78 MHz band for mobile devices is listed in Draft New Recommendation ITU-R SM.[WPT] with the intention of approval at SG1 / WP 1A meeting in June 2017.
- Other bands such as 100-300 kHz is still under consideration for Recommendation while no impact study results have been shared at WP 1A and 1B.
- WPT frequency ranges for EVs is listed as “urgent studies required in preparation for WRC-19 Agenda Items 9.1, Issue 9.1.6.
- WP 1A and 1B invite contributions to their developments of Report and/or Recommendation, impact studies, draft CPM text and suitable harmonized frequency ranges for WPT.
- Emission limits specification developments for WPT frequency ranges in particular 9-150 kHz are undertaken by CISPR and in progress.
- IEC 61980, ISO 19363, and SAE J2954 are developing international standards intended for global and regional harmonization on electric vehicle WPT systems.

Thank you

Follow us on:    

For more information, visit us at:

www.qualcomm.com & www.qualcomm.com/blog

Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2016 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm, Snapdragon, and Why Wait are trademarks of Qualcomm Incorporated, registered in the United States and other countries. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes Qualcomm’s licensing business, QTL, and the vast majority of its patent portfolio. Qualcomm Technologies, Inc., a wholly-owned subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of Qualcomm’s engineering, research and development functions, and substantially all of its product and services businesses, including its semiconductor business, QCT.



“Appendix



Emission limits for WPT mobile devices using 6.78 MHz band (magnetic coupling) in Japan

Effective since March 2016

WPT target application	Conductive emission limits		Radiated emission limits of fundamental wave	Radiated emission limits in other bands			
	9-150 kHz	150 kHz - 30 MHz	6.765-6.795 MHz	9-150 kHz	150 kHz - 30 MHz	30 MHz - 1 GHz	1-6 GHz
WPT for mobile devices using 6.78 MHz	Not specified	0.15-0.50 MHz: Quasi-peak 66-56 dBuV (linearly decreasing with log(f)) Average 56-46 dBuV (linearly decreasing with log(f)) 0.50-5 MHz: Quasi-peak 56 dBuV, Average 46 dBuV 5-30 MHz: Quasi-peak 60 dBuV, Average 50 dBuV, except ISM bands	6.765-6.776 MHz: 44.0 dBuA/m at 10 m (quasi-peak); 6.776-6.795 MHz: 64.0 dBuA/m at 10 m (quasi-peak)	Not specified	Taking basis on CISPR 11 Ed. 5.1, converting to values at 10 m distance, emission limit linearly decreases with log(f) from 39 dBuA/m at 0.15 MHz to 3 dBuA/m at 30 MHz. Exception-1: 20.295-20.385 MHz: 4.0 dBuA/m at 10 m (quasi-peak). Exception-2: 526.5-1 606.5 kHz: -2.0 dBuA/m at 10 m (quasi-peak)	Taking basis on CISPR 11 Ed. 5.1, the following is applied:30-80.872 MHz: 30 dBuV/m; 80.872-81.88 MHz: 50 dBuV/m; 81.88-134.786 MHz: 30 dBuV/m; 134.786-136.414 MHz: 50 dBuV/m; 136.414-230 MHz: 30 dBuV/m; 230-1 000 MHz: 37 dBuV/m In the case CISPR 32 (Ed. 1.0) should be applied, the limits at 3 m in Table A.5 is applied. Exception: 33.825-33.975 MHz: 49.5 dBuV/m at 10 m (quasi-peak)	In the case CISPR 32 (Ed. 1.0) (1) should be applied, the limits at 3 m in Table A.5 of (1) is applied

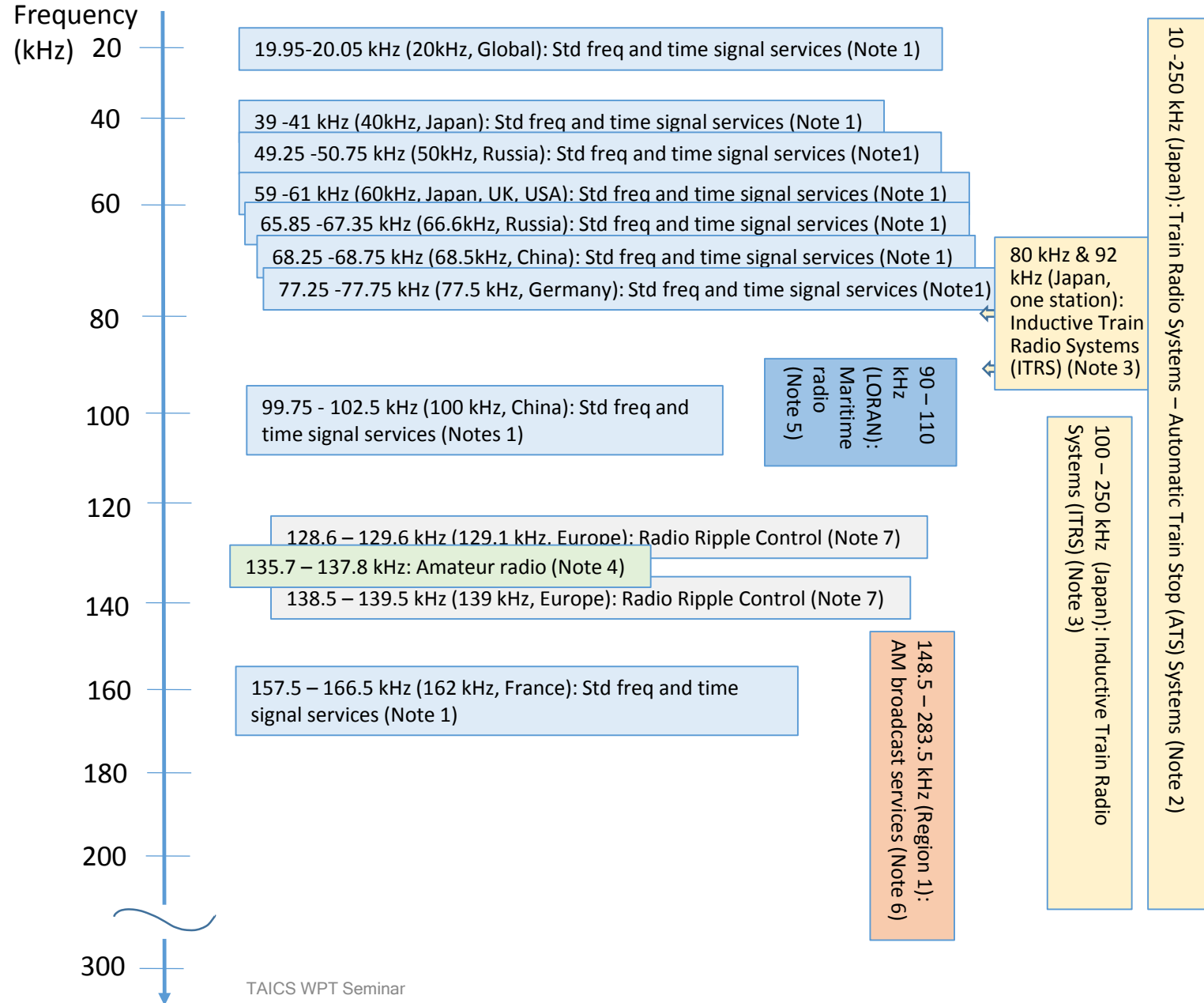
Emission limits for WPT for EV applications in Japan

Effective since March 2016

WPT target application	Conductive emission limits		Radiated emission limits of fundamental wave	Radiated emission limits in other bands			
	9-150 kHz	150 kHz - 30 MHz		79-90 kHz	9-150 kHz	150 kHz - 30 MHz	30 MHz - 1 GHz
WPT for EV charging	Not specified	0.15-0.50 MHz: Quasi-peak 66-56 dBuV (linearly decreasing with log(f)) Average 56-46 dBuV (linearly decreasing with log(f)), 0.50-5 MHz: Quasi-peak 56 dBuV, Average 46 dBuV 5-30 MHz: Quasi-peak 60 dBuV, Average 50 dBuV, except ISM bands	68.4 dBuA/m at 10 m. (quasi-peak)	23.1 dBuA/m at 10 m. (quasi-peak), except 79-90 kHz	Taking basis on CISPR 11 Ed. 5.1, converting to values at 10 m distance, linearly decreasing with log(f) from 39 dBuA/m at 0.15 MHz to 3 dBuA/m at 30 MHz (1). Exception-1: For 158-180 kHz, 237-270 kHz, 316-360 kHz, and 395-450 kHz, emission limits is higher than (1) above by 10 dB. Exception-2: For 526.5-1 606.5 kHz, -2.0 dBuA/m (quasi-peak)	Taking basis on CISPR 11 Ed. 5.1, the following is applied: 30-80.872 MHz: 30 dBuV/m; 80.872-81.88 MHz: 50 dBuV/m; 81.88-134.786 MHz: 30 dBuV/m; 134.786-136.414 MHz: 50 dBuV/m; 136.414-230 MHz: 30 dBuV/m; 230-1 000 MHz: 37 dBuV/m	Not specified

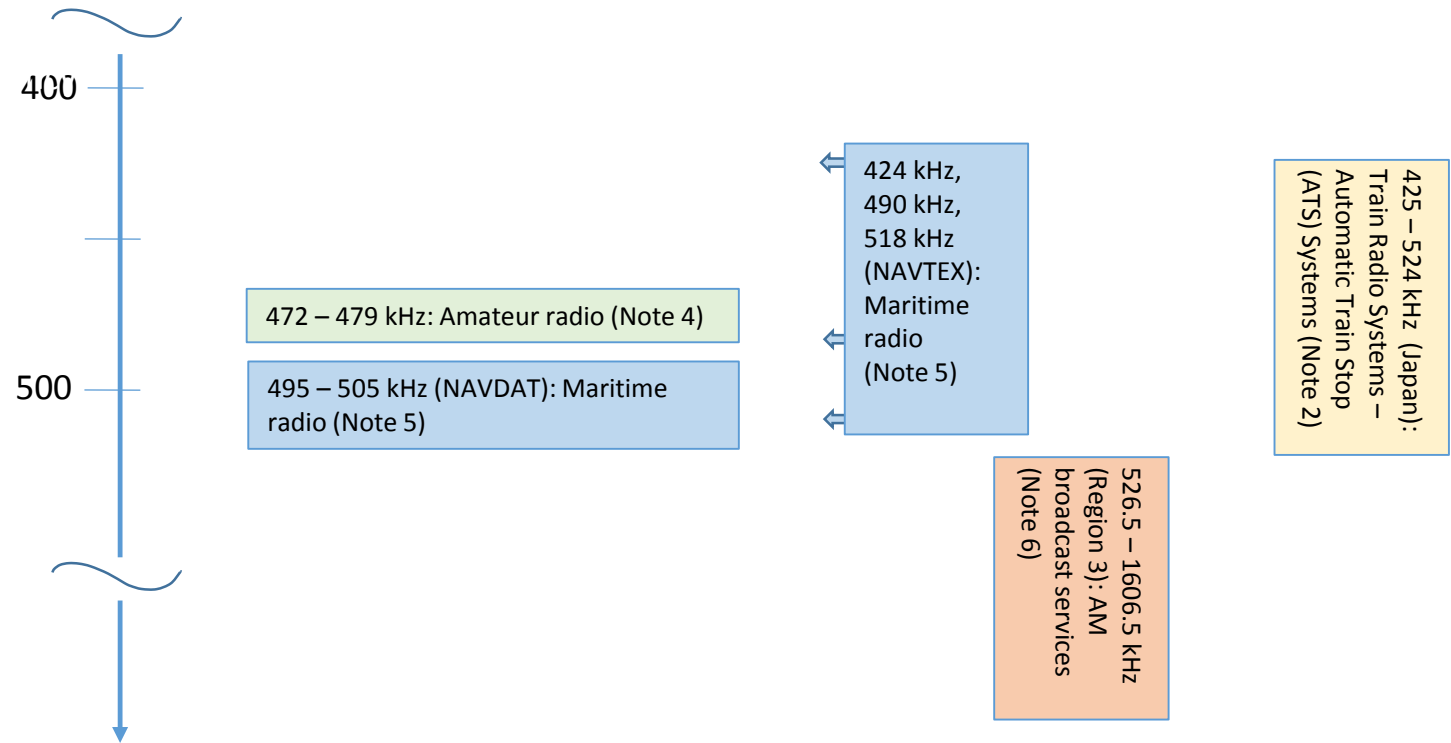
Frequency Chart of radio-communication systems in LF band (kHz)

Survey for suitable WPT frequency ranges (fundamental wave) for EV applications;



Frequency Chart of radio-communication systems in MF band (kHz)

WPT harmonic waves may fall into this frequency range.



- Note 1: Amplitude modulation (BCD); The clocks and watches that periodically receive digital signals of the standard time transmitted from the standard-time-signal transmitting stations to synchronize and adjust own time.
- Note 2: Telecommunication system that applying electric current to coils installed along with railroad track and detects electric current carried through coils which are installed on train vehicles on the rail to control trains.
- Note 3: Signal transmission system which uses inductive coupling between transmission line which is installed along with the railroad track and so forth and antenna that is installed on train vehicles.
- Note 4: Radio service with transmitter and receiver devices used for technology research and training of amateur radio operators.
- Note 5: Pulse, FSK etc. Radio system that secures safety of vessel operation which is used at port and harbor or on the sea.
- Note 6: Amplitude modulation; Audio broadcasting service with receiver devices which use long wave or medium wave band.
- Note 7: A radio system used for load / demand control of electricity, which communicates over the electrical distribution system.