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**APT Survey Report ON**

**Radio FREQUENCY BEAM WPT**

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**APT Survey Report ON**

**Radio FREQUENCY BEAM WPT**

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Appendix 1 Questionnaire

1. **Introduction**

Wireless Power Transmission (WPT) is a technology making it possible to transfer / transmit electrical energy from a power source to an electrical load without a cable interconnection. Non-Beam WPT systems using magnetic coupling and capacitive coupling technologies are already widely used for many applications, such as electric vehicles, mobile devices and consumer electric devices.

Recently, for many researches and developments regarding WPT technologies, radio frequency beam WPT using microwave radio beam is the focal point. In some countries, radio frequency beam WPT systems are already commercialized for applications to IoT sensor devices, mobile devices and other low-power devices. New regulations specialized for radio frequency beam WPT are also being developed in some APT countries.

In ITU-R, a Report summarizing applications of radio frequency beam WPT was already published as [Report ITU-R SM.2392-0](https://www.itu.int/pub/R-REP-SM.2392), “Applications of wireless power transmission via radio frequency beam”, in 2016, and revised in 2021. In addition, at ITU-R SG1 meeting in July 2022, a draft new [Recommendation ITU-R SM.[WPT.BEAM.FRQ]](https://www.itu.int/md/R19-SG01-C-0108/en) “*Guidance on frequency ranges for operation of wireless power transmission via radio frequency beam for mobile/portable devices and sensor networks”* (see [Doc. 1/108(Rev.2)](https://www.itu.int/md/R19-SG01-C-0108/en)) was agreed to move forward to the approval process (see BR [CACE/1034](https://www.itu.int/md/R00-CACE-CIR-1034/en) of 20 July 2022), and a new [Report ITU-R SM.2505-0](https://www.itu.int/pub/R-REP-SM.2505) *“Impact studies and human hazard issues for wireless power transmission via radio frequency beam*” was approved. In the draft new [Recommendation ITU-R SM.[WPT.BEAM.FRQ],](https://www.itu.int/md/R19-SG01-C-0108/en) frequency ranges in 920 MHz band, 2.4 GHz band, 5.7 GHz band and 61 GHz band are listed and it recommends that administrations may consider as guidance the use of the frequency ranges, or portions thereof, for the operation of beam WPT for mobile/portable devices and charging of sensor networks.

However, some frequency ranges indicated in Recommendation ITU-R SM.[WPT.BEAM.FRQ], may not be designated for ISM applications, and may not be available for beam WPT applications in some countries, as a result of the different national allocations and regulatory conditions.

In some administrations in Regions 1 and 3, the compatibility study of beam WPT is still ongoing and the available frequency ranges for beam WPT are still under consideration.

Regarding international standardization, IEC TC 100 is developing new Technical Reports (TRs) and/or International Standards (ISs) for radio frequency beam WPT systems applied to Audio, video and multimedia systems and equipment. CISPR B has also started to develop EMC standards for radio frequency beam WPT systems.

The purpose of this Survey Report is to collect information from administrations on the following points regarding radio frequency beam WPT;

- Demands for radio frequency beam WPT systems and their applications,

- Status of market,

- Status of regulations,

- Assigned or candidate frequency ranges,

- Incumbent radiocommunication services to be protected from radio frequency beam WPT systems.

This Survey Report is developed based on the responses to the questionnaire from APT members. It is helpful to understand the regulatory status of WPT in the Asia-Pacific region and can be a guide for further development of APT Recommendation(s)/Report(s).

The responses are summarized in Chapter 3.

1. **Respondents**

APT Members which submitted responses to the questionnaire and corresponding input documents are as follows:

**Table 2.1 Received Survey responses**

|  |  |  |
| --- | --- | --- |
| No. | Source | Input document |
| 1 | Iran  (Islamic Republic of) | AWG-29/INP-09 |
| 2 | Myanmar  (Republic of the Union of) | AWG-29/INP-11 |
| 3 | Japan | AWG-29/INP-27 |
| 4 | Indonesia | AWG-29/INP-45 |
| 5 | China  (People’s Republic of) | AWG-29/INP-61 |
| 6 | Cambodia (Kingdom of) | AWG-29/INP-91 |
| 7 | Thailand  (kingdom of) | AWG-30/INP-11 |
| 8 | Korea  (Republic of) | AWG-30/INP-41 |

1. **Summary of Questionnaire Responses**

**3.1 Commercialization status of radio frequency beam WPT systems/devices**

This is the response summary for Q**uestions 1, 2 and 3**

**Q1:**

Are there demands from industries and/or general users for radio frequency beam WPT systems in your country?

**<Answer>**

Yes No

**Q2:**

If the answer to the question No.1 is “Yes”, what applications are (will be) equipped with radio frequency beam WPT?

Please check all relevant applications.

**<Answer>**

Sensor devices

Mobile devices, such as smart phones

Computer peripheral devices, such as wireless mouses and wireless headphones

Moving machines, such as drones

Others, please specify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Q3:**

If the answer of the question No.1 is “Yes”, how do you describe the current commercialization status of radio frequency beam WPT systems/devices?

**<Answer>**

Already, on the market

Commercialization will start in a few years

Probably to commercialize in the future

No plan to commercialize

**Table 3.1 Q1-Q3 Response Summary**

|  |  |  |  |
| --- | --- | --- | --- |
| **Current situation of demand, applications and commercialization status for** **radio frequency beam WPT systems/devices** | | | |
| Country/Region | Q1. Demand from industries and/or general users | Q2. Applications | Q3. Current commercialization status |
| Iran  (Islamic Republic of) | No | None | None |
| Myanmar  (Republic of the Union of) | Yes | Mobile devices, such as smart phones | Already, on the market |
| Japan | Yes | Sensor devices  Small display devices | Commercialization starts in 2022 |
| Indonesia | No | None | No plan to commercialize |
| China  (People’s Republic of) | No | None | None |
| Cambodia (Kingdom of) | Yes | Mobile devices, such as smart phones  Computer peripheral devices, such as wireless mouses and wireless headphones | Already, on the market |
| Thailand  (Kingdom of) | No | None | None |
| Korea  (Republic of) | Yes | Sensor devices  Mobile devices, such as smart phones  Computer peripheral devices, such as wireless mouses and wireless headphones  Moving machines, such as drones | Probably to commercialize in the future |

**3.2 Regulation status for radio frequency beam WPT systems/devices**

This is the response summary for Q**uestions 4, 5, 6, 7 and 8**.

**Q4:**

Can radio frequency beam WPT systems/devices be utilized in your countries’ current radio regulations?

**<Answer>**

Yes

No

**Q5:**

Does your country have some plans to establish new regulations for radio frequency beam WPT systems/devices?

**<Answer>**

Yes

No

**Q6:**

If the answer to the question No.4 or No.5 is “Yes”, what radio regulatory category is (will be) assumed for radio frequency beam WPT systems/devices?

**<Answer>**

ISM equipment

SRD

licensed radio equipment

un-licensed radio equipment

Others, please specify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Q7:**

If the answer to the question No. 4 or No.5 is “Yes”, what frequency ranges are (will be) regulated for radio frequency beam WPT systems/devices?

Please check all possible frequency ranges.

**<Answer>**

920 MHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2.4 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5.7 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

24 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

61 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Others, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Q8:**

If the answer to the question No.4 or No.5 is “Yes”, what incumbent radiocommunication services should be protected from radio frequency beam WPT systems/devices?

Please check all possible incumbent systems and specify their frequency ranges.

**<Answer>**

Wireless LAN, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mobile communication systems, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

RF-ID, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Radio astronomy, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Amateur radio, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DSRC, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Broadcasting services, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Weather radar, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Others, please specify incumbent systems\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

and please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Table 3.2 Q4-Q6 Response Summary**

|  |  |  |  |
| --- | --- | --- | --- |
| **Regulation status for radio frequency beam WPT systems/devices** | | | |
| Country/Region | Q4. Current radio regulations | Q5. Plans to establish new regulations | Q6. Radio regulatory category |
| Iran  (Islamic Republic of) | No | No | This regulation is developing and not define which category of license will be used yet. |
| Myanmar  (Republic of the Union of) | Yes | Yes | ISM equipment  SRD  Un-licensed radio equipment |
| Japan | Yes | Yes  New regulations were enforced in May 2022. | Licensed radio equipment |
| Indonesia | No | Yes | SRD |
| China  (People’s Republic of) | No | No | None |
| Cambodia (Kingdom of) | Yes | Yes | ISM equipment  un-licensed radio equipment |
| Thailand  (Kingdom of) | No | No | None |
| Korea  (Republic of) | No | Yes | None |

**Table 3.3 Q7-Q8 Response Summary**

|  |  |  |
| --- | --- | --- |
| **Regulation status for radio frequency beam WPT systems/devices** | | |
| Country/Region | Q7. Frequency ranges | Q8. incumbent radiocommunication services protected from radio frequency beam WPT systems/device |
| Iran  (Islamic Republic of) | This regulation is developing and not define which category of license will be used yet. | 1. Wireless LAN   frequency range: 5725-5850 MHz, 24-24.250 GHz, 57-64 GHz and 57-64 GHz in SRDs  (2) Mobile communication systems  frequency range: According to APT/AWG/REP-15 |
| Myanmar  (Republic of the Union of) | 920 MHz band  2.4 GHz band  5.7 GHz band   1. GHz band | 1. Wireless LAN   frequency ranges: 2.4 GHz, 5.7 GHz and 24 GHz   1. RF-ID   frequency range: 919-924 MHz |
| Japan | 920 MHz band,  917-920 MHz  2.4 GHz band,  2.410-2.486 GHz  5.7 GHz band,  5.738-5.766 GHz | 1. 920 MHz band beam WPT    1. Mobile communication systems   frequency range: LTE-A (Band 8) 900 - 915 MHz (uplink), 945 - 960 MHz (downlink)   * 1. RF-ID   frequency range: 916.7 - 923.5 MHz, 915.9 - 929.7 MHz   * 1. Radio astronomy   frequency range: 1 400 - 1 427 MHz   * 1. Digital MCA Service   frequency range: 930 - 940 MHz (uplink), 940 - 945 MHz (downlink)   * 1. Advanced MCA Service   frequency range: 895 - 900 MHz (uplink), 850 - 860 MHz (downlink)   1. 2.4 GHz band beam WPT   (2-1) Wireless LAN  frequency range: 2 400 - 2 497 MHz  (2-2) Mobile communication systems  frequency range: Geostationary Mobile Satellite System 2 500 - 2 535 MHz, Non-Geostationary Mobile Satellite System 2 483.55 - 2 500 MHz  (2-3)　Radio astronomy  frequency range: 2 695 MHz  (2-4) Amateur radio  frequency range: 2 400 - 2 450 MHz  (2-5) Premises radio  frequency range: 2 400 - 2 483.5 MHz  (2-6) Field Pickup (FPU) for broadcasting  frequency range: 2 330 - 2 370 MHz  (2-7) Unmanned mobile image transmission system (Wireless system for drones and other unmanned vehicles)  frequency range: 2 483.5 - 2 494 MHz  (3) 5.7 GHz band beam WPT  (3-1) Wireless LAN  frequency range: 5 470 - 5 730 MHz  (3-2) Radio astronomy  frequency range: 4 990 - 5 000 MHz, 10 600 - 10 700 MHz  (3-3) Amateur radio  frequency range: 5 650 - 5 850MHz  (3-4) DSRC  frequency range: 5 770 - 5 850 MHz  (3-5) Weather radar  frequency range: 5 250 - 5 372.5 MHz  (3-6) Studio to Transmitter Link (STL) & Transmitter to Transmitter Link (TTL) for broadcasting  frequency range: 5 850 - 5 925 MHz  (3-7) Field Pickup (FPU) & Transmitter to Studio Link (TSL) systems for broadcasting  frequency range: 5 850 - 5 925 MHz  (3-8) Unmanned mobile image transmission system (Wireless system for drones and other unmanned vehicles)  frequency range: 5 650 - 5 755 MHz |
| Indonesia | Not yet specified | 1. Wireless LAN   frequency range: 2 400 – 2 483,5 MHz, 5 150 – 5 250 MHz, 5 250 – 5 350 MHz, 5 725 – 5 825 MHz,   1. Mobile communication systems   frequency range: 880-915 MHz, 925- 960 MHz   1. RF-ID   frequency range: 920 – 923 MHz   1. DSRC   frequency range: 5 725 – 5 825 MHz   1. LPWA 920-923 MHz 2. other services that should be protected will have to wait for the result future impact studies |
| China  (People’s Republic of) | None | None |
| Cambodia (Kingdom of) | 920 MHz band  frequency range:  920-923 MHz  2.4 GHz band  frequency range:  2 400-2 500 MHz  5.7 GHz band  frequency range:  5 725-5 875 MHz  24 GHz band  frequency range:  24-24.25 GHz  61 GHz band  frequency range:  61-61.5 GHz | 1. Wireless LAN   frequency range: 2 400-2 483.5 MHz, 5 150-5 350 MHz, 5 470-5 725 MHz,5 725-5 850 MHz   1. Mobile communication systems   frequency range: Band 850 MHz (UL: 824-849 MHz, DL: 869-894 MHz),  Band 900 MHz (UL: 880-915 MHz, DL: 925-960 MHz),  Band 1800 MHz (UL:1 710-1 785 MHz, DL: 1 805-1 880 MHz),  Band 2100 MHz (UL: 1 920-1 980 MHz, 2 110-2 170 MHz),  Band 40 (TDD, 2 300-2 400 MHz),  Band 7 (UL: 2 500-2 570 MHz, DL: 2 620-2 690 MHz),  Band 38 (TDD, 2 570-2 620 MHz)   1. RF-ID   frequency range: 923-925 MHz, 866-869 MHz   1. Broadcasting service   frequency range: AM: 526.5-1 606.5 kHz  VHF Band II: 87.5-108 MHz  VHF Band III: 174-230 MHz  UHF band IV: 470-622 MHz  UHF Band V: 622-862 MHz   1. Weather radar   frequency range: 2 860-2 900 MHz |
| Thailand  (Kingdom of) | None | None |
| Korea  (Republic of) | None | 1. Wireless LAN   frequency range: 2 400-2 483.5 MHz, 5 150-5 825 MHz   1. Mobile communication systems   frequency range: 949.3-959.3 MHz, 2 500-2 550 MHz   1. RF-ID   frequency range: 917 -923.5 MHz   1. Radio astronomy   frequency range: 5.65-5.85 GHz   1. DSRC   frequency range: 5.895-5.905 GHz |

**Table 3.4 Summary of Frequency Ranges Regulated and/or Planned for Radio Frequency Beam WPT**

|  |  |
| --- | --- |
| **Frequency ranges regulated or planned for radio frequency beam WPT** | |
| Frequency band | Frequency range |
| 920 MHz band | 920-923 MHz (Cambodia)  917-920 MHz (Japan)  Not specified (Myanmar) |
| 2.4 GHz band | 2 400-2 500 MHz (Cambodia)  2 400-2 486 MHz (Japan)  Not specified (Myanmar) |
| 5.7 GHz band | 5 725-5 875 MHz (Cambodia)  5 738-5 766 MHz (Japan)  Not specified (Myanmar) |
| 24 GHz band | 24-24.25 GHz (Cambodia)  Not specified (Myanmar) |
| 61 GHz band | 61-61.5 GHz (Cambodia) |

**3.3.　Status of studies on impact on radiocommunication services**

This is the response summary for Q**uestion 9**.

Q9:

Do you have any study results on impact on radiocommunication services, any on-going studies, or any plans of impact studies?

**<Answer>**

Yes. We have some impact study results.

(Could you explain the study briefly?)

Yes. We have on-going studies.

(Could you explain the study briefly?)

Not yet started but, we have some plans of impact study.

(Could you explain the plans briefly?)

No.

**Table 3.5 Summary table of Question 9**

|  |  |
| --- | --- |
| **Status of studies on impact on radiocommunication services** | |
| Country/Region | Answer |
| Iran  (Islamic Republic of) | No |
| Myanmar  (Republic of the Union of) | Not yet started, but we have some plans of impact study. |
| Japan | Yes. We have some impact study results.  The Ministry of Internal Affairs and Communications (MIC) of Japan released the report on technical requirements for specific radio frequency beam WPT including related impact studies in July 2020.  The abstracts of the report are described in Working Document towards A DRAFT NEW APT REPORT ON RADIO FREQUENCY BEAM WIRELESS POWER TRANSFER/TRANSMISSION (WPT) in Doc. AWG-28/TMP-38 (Rev.1)).  The impact study results are also described in Report ITU-R SM.2505-0 which was approved in SG 1 meeting in July 2022. |
| Indonesia | No |
| China  (People’s Republic of) | No |
| Cambodia (Kingdom of) | No |
| Thailand  (Kingdom of) | No |
| Korea  (Republic of) | No |

1. **Conclusion**

This Report presents the survey results on radio frequency beam WPT based on the responses from APT countries to the “[Questionnaire on radio frequency beam wireless power Transmission”](https://www.apt.int/sites/default/files/Upload-files/Circulars/Questionnaire_on_non-beam_WPT_in_300_-_400_KHz_1610_-_1950_KHz_and_1950_-2150_KHz.docx).

From the consolidated results in Table 3.1, radio frequency beam WPT systems/devices are already commercialized in three APT countries. Major applications of radio frequency beam WPT are mobile devices including smart phones, sensor devices, small display devices, and computer peripheral devices, such as wireless mouses and wireless headphones.

Regulation status for radio frequency beam WPT systems/devices are summarized in Tables 3.2, 3.3 and 3.4. Regulations for radio frequency beam WPT systems/devices are already enforced in three APT countries. Some APT countries have their plans to develop new regulations for radio frequency beam WPT systems/devices. Radio regulatory categories regulated or considered vary country by country. ISM equipment, SRD, licensed radio equipment and un-licensed radio equipment are considered. As shown in Table 3.4, five frequency bands, 920 MHz band, 2.4 GHz band, 5.7 GHz band, 24 GHz band and 61 GHz band, are listed as the frequency bands for regulated or planned for radio frequency beam WPT. For coexistence purpose, incumbent radiocommunication services to be protected from radio frequency beam WPT systems/device are listed as shown in Table 3.3.

Impact studies are important for coexistence with other radio communication services including radio astronomy. Currently, one administration has published the impact study results. Other administrations have plans of impact studies.

**Appendix 1**

**Questionnaire**

**Questions:**

1. Are there demands from industries and/or general users for radio frequency beam WPT systems in your country?

**<Answer>**

Yes No

1. If the answer to the question No.1 is “Yes”, what applications are (will be) equipped with radio frequency beam WPT?

Please check all relevant applications.

**<Answer>**

Sensor devices

Mobile devices, such as smart phones

Computer peripheral devices, such as wireless mouses and wireless headphones

Moving machines, such as drones

Others, please specify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. If the answer of the question No.1 is “Yes”, how do you describe the current commercialization status of radio frequency beam WPT systems/devices?

**<Answer>**

Already, on the market

Commercialization will start in a few years

Probably to commercialize in the future

No plan to commercialize

1. Can radio frequency beam WPT systems/devices be utilized in your countries’ current radio regulations?

**<Answer>**

Yes

No

1. Does your country have some plans to establish new regulations for radio frequency beam WPT systems/devices?

**<Answer>**

Yes

No

1. If the answer to the question No.4 or No.5 is “Yes”, what radio regulatory category is (will be) assumed for radio frequency beam WPT systems/devices?

**<Answer>**

ISM equipment

SRD

licensed radio equipment

un-licensed radio equipment

Others, please specify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. If the answer to the question No. 4 or No.5 is “Yes”, what frequency ranges are (will be) regulated for radio frequency beam WPT systems/devices?

Please check all possible frequency ranges.

**<Answer>**

920 MHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2.4 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5.7 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

24 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

61 GHz band, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Others, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. If the answer to the question No.4 or No.5 is “Yes”, what incumbent radiocommunication services should be protected from radio frequency beam WPT systems/devices?

Please check all possible incumbent systems and specify their frequency ranges.

**<Answer>**

Wireless LAN, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mobile communication systems, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

RF-ID, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Radio astronomy, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Amateur radio, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DSRC, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Broadcasting services, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Weather radar, please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Others, please specify incumbent systems\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

and please specify frequency range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Do you have any study results on impact on radiocommunication services, any on-going studies, or any plans of impact studies?

**<Answer>**

Yes. We have some impact study results.

(Could you explain the study briefly?)

Yes. We have on-going studies.

(Could you explain the study briefly?)

Not yet started but, we have some plans of impact study.

(Could you explain the plans briefly?)

No.