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자동 생성된 설명**

**APT REPORT ON**

**FIXED WIRELESS SYSTEMS**

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**APT Report on FIXED WIRELESS SYSTEMS**

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# 1. Introduction

In addition to the increase in demand for backbone wireless communication systems for mobile backhaul due to the rapid traffic increase in mobile networks, fixed wireless systems are expected to be widely used in diverse applications including FWA (Fixed Wireless Access), disaster mitigation purposes, infrastructure-related networks, and high-resolution image transmission.

Reflecting such an increase in demand for fixed wireless systems, active discussions for developing technical standards on fixed wireless systems are being carried out at ITU-R SG5 WP5C [1] and other international standardization organizations, such as ECC (Electronics Communications Committee). Based on preliminary results in [1], demands in the millimeter wave frequency for each country are increasing, especially E-band and V-band.

In the Asia-Pacific region, however, while some countries are starting research and development in anticipation of future market development, specific activities for technology standardization have not yet taken place. Moreover, in the Asia-Pacific region, demand on wireless transmission solution for mobile network is significant due to the growth in mobile network. Introduction of suitable technology for the region is therefore desired.

Considering the circumstances above, to progress research on frequency use, relevant technologies and future needs for fixed wireless communication in the Asia-Pacific region is critical in order to promote the incorporation of fixed wireless systems in a wide range of application fields, to expand the market, and at the same time, to realize effective use of a wide range of frequency bands in micro and millimeter waves.

At the AWG-15 held in Bangkok, August 2013, an ad-hoc investigation group was established under Working Group Technology Aspects for discussing about the establishment of a new task group that handles fixed wireless systems. The establishment of the new Task Group (TG-FWS) was approved at the closing plenary of AWG-15, at the same time, Terms of References and work plan of TG-FWS were approved as AWG-15 output documents.

Given such circumstances, and in accordance with the work plan, a questionnaire to gather information regarding current usage, demand and market forecast, standardization, guidelines, future plans and research and development status for fixed wireless systems was developed at AWG-16 for APT members to answer. Based on the received responses from the APT members, this Survey Report is developed and would be used for further development of APT Recommendation(s)/Report(s).

## 1.1. Questionnaire

The questionnaire [2] is composed of 17 questions divided into 6 parts, composing of current situation in each country, demand and market forecast, standardization, future plans and research and development.

## 1.2. Questionnaire responses

The questionnaire responses were received from the following APT members contained in AWG-17/INP-49.

Table 1 Questionnaire responses

|  |  |
| --- | --- |
| No | APT member |
| 1 | Australia |
| 2 | China Mobile, China Telecom and China Unicom |
| 3 | Iran (Islamic Republic of) |
| 4 | Japan |
| 5 | Korea (Republic of) |
| 6 | Singapore (Republic of) |
| 7 | Thailand |
| 8 | Socialist Republic of Vietnam |

# 2. Current status of assignment/usage of frequency for Fixed Wireless Systems (FWS)

## 2.1 Frequency bands allocated to the fixed service in the ITU Radio Regulations

The frequency bands allocated to fixed service for region 3 in the ITU Radio Regulations [3] from 2 GHz to 100 GHz are shown below.

|  |
| --- |
| 2 GHz (2.01-2.69) |
| 3 GHz (3.4-4.2) |
| 4 GHz (4.4-5) |
| 6 GHz (5.85-7.075) |
| 7 GHz (7.075-7.9) |
| 8 GHz (7.9-8.5) |
| 9 GHz (9.8-10) |
| 10 GHz (10-10.45/10.5-10.68) |
| 11 GHz (10.7-11.7) |
| 12 GHz (11.7-12.7) |
| 13 GHz (12.7-13.25) |
| 14 GHz (14.3-14.5) |
| 15 GHz (14.4-15.35) |

|  |
| --- |
| 18 GHz (17.7-19.7) |
| 23 GHz (21.2-23.6) |
| 27 GHz (24.25-29.5) |
| 31 GHz (31-31.3) |
| 32 GHz (31.5-33.4) |
| 38 GHz (36-40.5) |
| 42 GHz (40.5-43.5) |
| 49 GHz (47.2-50.2) |
| 52 GHz (50.4-52.6) |
| 57 GHz (55.78-59) |
| 60 GHz (59-66) |
| 70/80 GHz (71-76/81-86) |
| 95 GHz (92-94/94.1-100) |

## 2.2 Current status of FWS frequency in the Asia-Pacific region

## 2.2.1 Australia

|  | freq range  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assign freq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2GHz (2.010-2.690)** | 1.9–2.3 | 29 | a | a | a | 300 | a | a | a.b,d |  |
| **2GHz (2.010-2.690)** | 2.025–2.285 | 14 | a | a | a | 150 | a | a | a,b,d |  |
| **2GHz (2.010-2.690)** | 2.01–2.11, | ≤ 24 | d | a | b |  | d | d | a,b,d |  |
| **2GHz (2.010-2.690)** | 2.2–2.29 | ≤ 16 | d | a | b |  | d | d | a,b,d |  |
| **2GHz (2.010-2.690)** | 2.57–2.62 | ≤ 15 | d | a | b |  | d | d | a,b,d |  |
| **2GHz (2.010-2.690)** | 2.302–2.4 | 5–20 | b |  | b | 31000 | a.b | d | a,b,d |  |
| **3 GHz (3.400-4.200)** | 3.425–3.575 | 1–20 | b |  | b | 1100 | b | d | a,b,d |  |
| **3 GHz (3.400-4.200)** | 3.425–3.7 | 3.5–20 | b |  | b | 450 | a | a | a,b,d |  |
| **3 GHz (3.400-4.200)** | 3.58–4.2 | 29–40 | a | c | a | 300 | a | a | a,b,d |  |
| **6 GHz (5.850-7.075)** | 5.925–6.425 | 29.65 | a | a,c | a | 2150 | a | a | a,b,d |  |
| **6 GHz (5.850-7.075)** | 6.425–7.11 | 40 | a | c | a | 2900 | a | a | a,b,d |  |
| **7 GHz (7.075-7.900)** | 7.1–7.425 | 30 | d |  | a | 10 | d | a | a,b,d |  |
| **7 GHz (7.075-7.900)** | 7.425–7.725 | 7/14 | a | a | a | 2300 | a | a | a,b,d |  |
| **8 GHz (7.900-8.500)** | 7.725–8.275 | 29.65 | a | a,c | a | 6400 | a | a | a,b,d |  |
| **8 GHz (7.900-8.500)** | 8.275–8.4 | 28 | d |  | a | 10 | d | a | a,b,d |  |
| **9 GHz (9.800-10.00)** |  |  |  |  |  |  |  |  |  |  |
| **10 GHz (10.0-10.68)** | 10.55–10.68 | 7/14 | a | a | a | 550 | a | a | a,b,d |  |
| **11 GHz (10.7-11.7)** | 10.7–11.7 | 40 | a | a | a | 5550 | a | a | a,b,d |  |
| **12 GHz (11.7-12.7)** |  |  |  |  |  |  |  |  |  |  |
| **13 GHz (12.7-13.25)** | 12.75–1.325 | 28 | a,d | a,b | a | 2150 | a,d | a | a,b,d |  |
| **14 GHz (14.25-14.5)** |  |  |  |  |  |  |  |  |  |  |
| **15 GHz (14.4-15.35)** | 14.5–15.35 | 7/14/28 | a | a,b | a | 3900 | a | a | a,b,d |  |
| **18 GHz (17.7-19.7)** | 17.7–19.7 | 7.5/13.75/27.5/55 | a | a,b,c | a | 7000 | a | a | a,b,d |  |
| **23 GHz (21.2-23.6)** | 21.2–23.6 | 3.5/7/14/28/50 | a,d | a | a | 3050 | a | a | a,b,d |  |
| **27 GHz (24.25-29.5)** |  |  |  |  |  |  |  |  |  |  |
| **31 GHz (31.0-31.3)** |  |  |  |  |  |  |  |  |  |  |
| **32 GHz (31.8-33.4)** |  |  |  |  |  |  |  |  |  |  |
| **38 GHz (36.0-40.5)** | 37–39.5 | 7/14/28 | a | a | a | 1600 | a | a | a,b,d |  |
| **42 GHz (40.5-43.5)** |  |  |  |  |  |  |  |  |  |  |
| **49 GHz (49.2–49.95)** | 49.2–49.95 | 40 | a | a | a |  | a | a | a,b,d |  |
| **50 GHz (50.4–51.15)** | 50.4–51.15 | 40 | a | a | a | 50 | a | a | a,b,d |  |
| **52 GHz (51.4-52.6)** |  |  |  |  |  |  |  |  |  |  |
| **57 GHz (55.78-59.0)** | 57.2–58.2 | 100 | a |  | a | 50 | a | a | b |  |
| **60 GHz (59.0-66.0)** |  |  |  |  |  |  |  |  |  |  |
| **70/80 GHz (71-76/81-86)** | 71–76 |  | a |  | a | 150 | a | a | b |  |
| **70/80 GHz (71-76/81-86)** | 81–86 |  | a |  | a | 100 | a | a | b |  |
| **95 GHz (92.0-94/94.1-100)** |  |  |  |  |  |  |  |  |  |  |

If there are any references about (4) Way of assigning frequency, (5) Licensing or (6) Licensing fee basis, please write it down.

|  |
| --- |
| <http://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing>  <http://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Apparatus-licences>  <http://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Class-licences>  <http://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences>  <http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma> |

Additionally, if your answer of (5) Licensing is ‘b: light licensing’, please provide details of the method.

|  |
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|  |

## 2.2.2 China Mobile, China Telecom, China Unicom

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency band** | freqrange  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assignfreq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| **2GHz (2.010-2.690)** |  |  |  |  |  |  |  |  |  |  |
| **3 GHz (3.400-4.200)** |  |  |  |  |  |  |  |  |  |  |
| **6 GHz (5.850-7.075)** |  |  |  |  |  |  |  |  |  |  |
| **7 GHz (7.075-7.900)** |  |  |  |  |  |  |  |  |  |  |
| **8 GHz (7.900-8.500)** |  |  |  |  |  |  |  |  |  |  |
| **9 GHz (9.800-10.00)** |  |  |  |  |  |  |  |  |  |  |
| **10GHz (10.0-10.68)** |  |  |  |  |  |  |  |  |  |  |
| **11 GHz (10.7-11.7)** |  |  |  |  |  |  |  |  |  |  |
| **12 GHz (11.7-12.7)** |  |  |  |  |  |  |  |  |  |  |
| **13 GHz (12.7-13.25)** |  | 7M  14M  28M  56M | b,c | c | a |  | c | a | a | 30 |
|  |  |  |  |  |  |  |  |  |  |  |
| **14 GHz (14.25-14.5)** |  |  |  |  |  |  |  |  |  |  |
| **15 GHz (14.4-15.35)** |  |  |  |  |  |  |  |  |  |  |
| **18 GHz (17.7-19.7)** |  |  |  |  |  |  |  |  |  |  |
| **23 GHz (21.2-23.6)** |  |  |  |  |  |  |  |  |  |  |
| **27 GHz (24.25-29.5)** |  |  |  |  |  |  |  |  |  |  |
| **31 GHz (31.0-31.3)** |  |  |  |  |  |  |  |  |  |  |
| **32 GHz (31.8-33.4)** |  |  |  |  |  |  |  |  |  |  |
| **38 GHz (36.0-40.5)** |  |  |  |  |  |  |  |  |  |  |
| **42 GHz (40.5-43.5)** |  |  |  |  |  |  |  |  |  |  |
| **52 GHz (51.4-52.6)** |  |  |  |  |  |  |  |  |  |  |
| **57 GHz (55.78-59.0)** |  |  |  |  |  |  |  |  |  |  |
| **60 GHz (59.0-66.0)** |  | 200M | b | a | a |  | c | b | a | 3 |
| **70/80 GHz (71-76/81-86)** |  | 250M  500M  750M | c | e | a |  | c | b | a | 19 |
| **95 GHz (92.0-94/94.1-100)** |  |  |  |  |  |  |  |  |  |  |

If there are any references about (4)Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please write it down.

|  |
| --- |
| License fee based on the function, for example XPIC, header compression, MPLS-TP so on. |

Additionally, if your answer of (5)Licensing is ‘b: light licensing’, please provide details of the method.

|  |
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|  |

## 2.2.3 Iran (Islamic Republic of)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency band** | freq range  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assign freq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| **2GHz (2.010-2.690)** | - | - | - | - | - | - | - | - | - | - |
| **3 GHz (3.400-4.200)** | 3.4-3.6 | 5 & 10 | b | a | b | many | B | d | A, b, c, d | WiMAX |
| 3.6-4.2 | 28 | a | c | a | many | A | a | a , b, c, d | - |
| **6 GHz (5.850-7.075)** | 5.925-6.425 | 29.650 | a | c | a | many | A | a | a , b, c, d | - |
| **7 GHz (7.075-7.900)** | 7.075-7.900 | 3.5  7  14  28 | a | a , b , c | a | many | D | A | a , b, c, d | - |
| **8 GHz (7.900-8.500)** | 7.900-8.500 | 7  14  28  29650 | a | a , b , c | a | many | D | A | a , b, c, d | - |
| **9 GHz (9.800-10.00)** | **-** | **-** | - | **-** | - | **-** | - | **-** | - | - |
| **10 GHz (10.0-10.68)** | 10.0-10.68 | 7  14 | a | a , b | a | Many | D | a | a , b, c, d | - |
| **11 GHz (10.7-11.7)** | 10.7-11.7 | 7  14  28 | a | b , c | a , b | Many | D | a | a , b, c, d | - |
| **12 GHz (11.7-12.7)** | 11.7-12.7 | 7  14  28 | a | b , c | a , b | Many | D | a | a , b, c, d | - |
| **13 GHz (12.7-13.25)** | 12.7-13.25 | 7  14 | a | b | a , b | Many | D | a | a , b, c, d | - |
| **14 GHz (14.25-14.5)** | 14.25-14.5 | 7 | b | a | A, b | few | d | a | a , b, c, d | - |
| **15 GHz (14.4-15.35)** | 14.4-15.35 | 3.5  7  14  28 | a | a , b ,c | a | Many | D | A | a , b, c, d | - |
| **18 GHz (17.7-19.7)** | 17.7-19.7 | 7  14  28 | a | b ,c | a | Many | D | A | a , b, c, d | - |
| **23 GHz (21.2-23.6)** | 21.2-23.6 | 28 | a | c | a | Many | d | A | a , b, c, d | - |
| **27 GHz (24.25-29.5)** | 24.25-29.5 | 28 | a | c | a | Few | d | A | a , b, c, d | - |
| **31 GHz (31.0-31.3)** | - | - | - | - | - | - | - | - | - | - |
| **32 GHz (31.8-33.4)** | - | - | - | - | - | - | - | - | - | - |
| **38 GHz (36.0-40.5)** | 36.0-40.5 | 28 | a | c | a | Many | d | A | a , b, c, d | - |
| **42 GHz (40.5-43.5)** | - | - | - | - | - | - | - | - | - | - |
| **52 GHz (51.4-52.6)** | - | - | - | - | - | - | - | - | - | - |
| **57 GHz (55.78-59.0)** | 57.2-58.2 | 100 | a | c , d | a | - | d | a | a , b, c, d | - |
| **60 GHz (59.0-66.0)** | - | - | - | - | - | - | - | - | - | - |
| **70/80 GHz (71-76/81-86)** | 71-76/81-86 | 250 | a , b | d , e | a | Few | d | a | a , b, c, d | - |
| **95 GHz (92.0-94/94.1-100)** | - | - | - | - | - | - | - | - | - | - |

If there are any references about (4)Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please write it down.

|  |
| --- |
|  |

Additionally, if your answer of (5) Licensing is ‘b: light licensing’, please provide details of the method.

|  |
| --- |
| We use 2.4 and 5.8 GHz band frequencies and we are considering 24GHz(24.05- 24.25 GHz) to assign Fix services ( point to point) |

## 2.2.4 Japan

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency**  **band** | Freq. range  [GHz] | BW  [MHz]  (min/  max) | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assign freq  (4) | licensing (5) | fee (6) | Max trans  Power  [dBm] |
| **2GHz (2.010-2.690)** | N/A |  |  |  |  |  |  |  |  |  |
| **3 GHz (3.400-4.200)** | N/A |  |  |  |  |  |  |  |  |  |
| **6 GHz (5.850-7.075)** | 5.925-6.425  6.570-6.870 | 2.5  53.5 | a,c,  a,c,e | c  a,b,c | a | 3700 | a | a | a, b, d | 33 |
| **7 GHz (7.075-7.900)** | 7.125-7.900 | 2.5  36.5 | e | a,b,c | a | 3100 | a | a | b | 33 |
| **8 GHz (7.900-8.500)** | N/A |  |  |  |  |  |  |  |  |  |
| **9 GHz (9.800-10.00)** | N/A |  |  |  |  |  |  |  |  |  |
| **10 GHz (10.0-10.68)** | N/A |  |  |  |  |  |  |  |  |  |
| **11 GHz (10.7-11.7)** | 10.7-11.7 | 5.0  72.5 | a,c,d | a,b,c | a | 8400 | a | a | b | － |
| **12 GHz (11.7-12.7)** | 12.2-12.5 | 5.0  36.5 | e | a,b,c | a | 1800 | a | a | b | 24 |
| **13 GHz (12.7-13.25)** | N/A |  |  |  |  |  |  |  |  |  |
| **14 GHz (14.25-14.5)** | N/A |  |  |  |  |  |  |  |  |  |
| **15 GHz (14.4-15.35)** | 14.4-15.35 | 5.0  72.5 | a,c,d | a,b,c | a | 4000 | a | a | b | － |
| **18 GHz (17.7-19.7)** | 17.7-19.7 | 60(max) | b,c,d,e | a,b,c | a | 6200 | a | a | b | 30 |
| **23 GHz (21.2-23.6)** | 22.0-23.2 | 60(max) | b,c | a,b,c | a | 1200 | a | a | b | 27 |
| **27 GHz (24.25-29.5)** | 25.25-27 | 60(max) | b,d | a,b,c | a | 4100 | a | a | b | 27 |
| **31 GHz (31.0-31.3)** | N/A |  |  |  |  |  |  |  |  |  |
| **32 GHz (31.8-33.4)** | N/A |  |  |  |  |  |  |  |  |  |
| **38 GHz (36.0-40.5)** | 37.5-39.5 | 60(max) | b,c,e | a | a | 160 | a | a | b | 27 |
| **42 GHz (40.5-43.5)** | N/A |  |  |  |  |  |  |  |  |  |
| **52 GHz (51.4-52.6)** | N/A |  |  |  |  |  |  |  |  |  |
| **57 GHz (55.78-59.0)** | N/A |  |  |  |  |  |  |  |  |  |
| **60 GHz (59.0-66.0)** | N/A |  |  |  |  |  |  |  |  |  |
| **70/80 GHz (71-76/81-86)** | 71-76/81-86 | 250  5000 | c, d,e | e,f | a | 15 | a | a | b | 30 |
| **95 GHz (92.0-94/94.1-100)** | N/A |  |  |  |  |  |  |  |  |  |

No. of stations : No. of stations which use field-portable system are not fully scored

No. of stations for mobile backhaul counts those for transport/trunking network.

If there are any references about (4)Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please write it down.

|  |
| --- |
| [licensing fee]  The licensee shall pay the license fee (spectrum user fee) every year. The licensee shall also pay the license application fee for application of the station.  For frequencies not exceeding 6GHz: The amount of the license fee per station depends on frequency range, frequency bandwidth, transmitter output power, and site location.  For frequencies exceeding 6GHz: The amount of the license fee is blanket per station.  The amount of the license fee of the station for temporary networks or the station of FWA is cheaper than those of other stations. |

Additionally, if your answer of (5)Licensing is ‘b: light licensing’, please provide details of the method.

|  |
| --- |
| No light licensing |

## 2.2.5 Korea (Republic of)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency band** | freq range  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assign freq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| **2GHz (2.010-2.690)** |  |  |  |  |  |  |  |  |  |  |
| **3 GHz (3.400-4.200)** | 4.4-4.94 | 40 | a,e |  |  |  |  |  | a, b | 40 |
| **6 GHz (5.850-7.075)** | 5.925-6.425 | 30 | a,e |  |  |  |  |  | a, b | 40 |
| **7 GHz (7.075-7.900)** | 6.430-7.110 | 5  10  20  40 | a,e |  |  |  |  |  | a, b | 40 |
| **8 GHz (7.900-8.500)** | 7.725-8.275 | 5  10  20  40 | a,b,d,e |  | a |  |  |  | a,b | 40 |
| **9 GHz (9.800-10.00)** |  |  |  |  | a |  |  |  |  |  |
| **10 GHz (10.0-10.68)** | 10.5-10.7 | 5  10  20 | a,b,e |  | a |  |  |  | a,b | 30 |
| **11 GHz (10.7-11.7)** | 10.7-11.7 | 5  10  20  40 | a,b,e |  | a |  |  |  | a, b | 40 |
| **12 GHz (11.7-12.7)** | 12.0-12.2 | 5  10  20 | a,b,e |  | a |  |  |  | a, b | 30 |
| **13 GHz (12.7-13.25)** |  |  |  |  |  |  |  |  |  |  |
| **14 GHz (14.25-14.5)** |  |  |  |  |  |  |  |  |  |  |
| **15 GHz (14.4-15.35)** |  |  |  |  |  |  |  |  |  |  |
| **18 GHz (17.7-19.7)** | 17.7-19.7 | 5  10  20  40  80 | a,b,d,e |  | a |  | a | a,b | a,b | 27 |
| **23 GHz (21.2-23.6)** | 21.65-23.4 | 25  50 | a,b,d,e |  | a |  | a | a,b | a,b | 27 |
| **27 GHz (24.25-29.5)** |  |  |  |  |  |  |  |  |  |  |
| **31 GHz (31.0-31.3)** |  |  |  |  |  |  |  |  |  |  |
| **32 GHz (31.8-33.4)** |  |  |  |  |  |  |  |  |  |  |
| **38 GHz (36.0-40.5)** | 36.5-38.99 | 3.5  7  14  28  56  140 | a,b,d |  | a |  | a | a,b | a,b | 27 |
| **42 GHz (40.5-43.5)** |  |  |  |  |  |  |  |  |  |  |
| **52 GHz (51.4-52.6)** |  |  |  |  |  |  |  |  |  |  |
| **57 GHz (55.78-59.0)** | 57-64 | 7000 | a,b,c,d | d,e | a |  | d | c |  | 27  57(EIRP) |
| **60 GHz (59.0-66.0)** |  |  |  |  |  |  |  |  |  |  |
| **70/80 GHz (71-76/81-86)** | 71-76  81-86 | 5000 | a,b,c,d | e,f | a |  | a | a,b | a,b | 35  85(EIRP) |
| **95 GHz (92.0-94/94.1-100)** |  |  |  |  |  |  |  |  |  |  |

If there are any references about (4)Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please write it down.

|  |
| --- |
| Enforcement ordinance of Radiocommunication Act |

Additionally, if your answer of (5)Licensing is ‘b: light licensing’, please provide details of the method.

|  |
| --- |
| Refer to Enforcement ordinance of Radiocommunication Act |

## 2.2.6 Singapore (Republic of)

| **Frequency band** | freq range  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assign freq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2GHz (2.010-2.690)** | - | - | - | - | - | - | - | - | - | - |
| **3 GHz (3.400-4.200)** | - | - | - | - | - | - | - | - | - | - |
| **6 GHz (5.850-7.075)** | 5.925 – 6.425 | 29.65 | e | - | a | - | a | a | a | - |
| 6.425 – 7.125 | 20.0 | e | - | a | - | a | a | a | - |
| **7 GHz (7.075-7.900)** | 7.125 – 7.425 | 7.0 | e | - | a | - | a | a | a | - |
| 7.425 – 7.725 | 7.0 | e | - | a | - | a | a | a | - |
| **8 GHz (7.900-8.500)** | 7.725 – 8.500 | 29.65 | e | - | a | - | a | a | a | - |
| **9 GHz (9.800-10.00)** | - | - | - | - | - | - | - | - | - | - |
| **10 GHz (10.0-10.68)** | 10.5 – 10.68 | 7.0  14.0 | e | - | a | - | a | a | a | - |
| **11 GHz (10.7-11.7)** | 10.7 – 11.7 | 20.0 | e | - | a | - | a | a | a | - |
| **12 GHz (11.7-12.7)** | 12.2 – 12.7 | 20.0 | e | - | a | - | a | a | a | - |
| **13 GHz (12.7-13.25)** | 12.75 – 13.25 | 28.0 | e | - | a | - | a | a | a | - |
| **14 GHz (14.25-14.5)** | - | - | - | - | - | - | - | - | - | - |
| **15 GHz (14.4-15.35)** | 14.4 – 15.35 | 7.0  14.0  28.0 | e | - | a | - | a | a | a | - |
| **18 GHz (17.7-19.7)** | 17.7 – 19.7 | 27.5  55.0 | c | - | b, c | - | a | a | a | - |
| **23 GHz (21.2-23.6)** | 21.2 – 23.6 | 3.5  7.0  14.0  28.0 | c | - | b, c | - | a | a | a | - |
| **27 GHz (24.25-29.5)** | - | - | - | - | - | - | - | - | - | - |
| **31 GHz (31.0-31.3)** | - | - | - | - | - | - | - | - | - | - |
| **32 GHz (31.8-33.4)** | - | - | - | - | - | - | - | - | - | - |
| **38 GHz (36.0-40.5)** | - | - | - | - | - | - | - | - | - | - |
| **42 GHz (40.5-43.5)** | - | - | - | - | - | - | - | - | - | - |
| **52 GHz (51.4-52.6)** | - | - | - | - | - | - | - | - | - | - |
| **57 GHz (55.78-59.0)** | - | - | - | - | - | - | - | - | - | - |
| **60 GHz (59.0-66.0)** | 57.1 – 62.9 | - | e | - | a | - | a | a | a | 55dBm EIRP |
| **70/80 GHz (71-76/81-86)** | - | - | - | - | - | - | - | - | - | - |
| **95 GHz (92.0-94/94.1-100)** | - | - | - | - | - | - | - | - | - | - |

If there are any references about (4)Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please write it down.

|  |
| --- |
| Exclusive use and shared use of frequencies are charged differently. |

Additionally, if your answer of (5)Licensing is ‘b: light licensing’, please provide details of the method.

|  |
| --- |
| N.A. |

## 2.2.7 Thailand

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency band** | freqrange  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assignfreq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| **2GHz (2.010-2.690)** |  |  |  |  |  |  |  |  |  |  |
| **3 GHz (3.400-4.200)** |  |  |  |  |  |  |  |  |  |  |
| **5 GHz** | 4.4-5.0 | 28  14 | a, c, d |  |  |  | a | a | a, b\* |  |
| **6 GHz (5.850-7.075)** | 6.43-7.11 | 40  20 | a, c |  |  |  | a | a | a, b\* |  |
| **7 GHz (7.075-7.900)** | 7.11-7.425, 7.425-7.725 | 28  14  7 | a, c |  |  |  | a | a | a, b\* |  |
| **8 GHz (7.900-8.500)** | 7.725-8.285 | 29.65 | a, c, d |  |  |  | a | a | a, b\* |  |
| **9 GHz (9.800-10.00)** |  |  |  |  |  |  |  |  |  |  |
| **10GHz (10.0-10.68)** |  |  |  |  |  |  |  |  |  |  |
| **11 GHz (10.7-11.7)** | 10.7-11.7 | 40  20 | a, c, d |  |  |  | a | a | a, b\* |  |
| **12 GHz (11.7-12.7)** |  |  |  |  |  |  |  |  |  |  |
| **13 GHz (12.7-13.25)** |  |  |  |  |  |  |  |  |  |  |
| **14 GHz (14.25-14.5)** |  |  |  |  |  |  |  |  |  |  |
| **15 GHz (14.4-15.35)** | 14.5-15.35 | 28  14  7  3.5 | a, c |  |  |  | a | a | a, b\* |  |
| **18 GHz (17.7-19.7)** | 17.7-19.7 | 27.5  13.75 | a, c |  |  |  | a | a | a, b\* |  |
| **23 GHz (21.2-23.6)** | 21.2-23.6 | 112  28  14  7  3.5 | a, c |  |  |  | a | a | a, b\* |  |
| **27 GHz (24.25-29.5)** |  |  |  |  |  |  |  |  |  |  |
| **31 GHz (31.0-31.3)** |  |  |  |  |  |  |  |  |  |  |
| **32 GHz (31.8-33.4)** |  |  |  |  |  |  |  |  |  |  |
| **38 GHz (36.0-40.5)** |  |  |  |  |  |  |  |  |  |  |
| **42 GHz (40.5-43.5)** |  |  |  |  |  |  |  |  |  |  |
| **52 GHz (51.4-52.6)** |  |  |  |  |  |  |  |  |  |  |
| **57 GHz (55.78-59.0)** |  |  |  |  |  |  |  |  |  |  |
| **60 GHz (59.0-66.0)** |  |  |  |  |  |  |  |  |  |  |
| **70/80 GHz (71-76/81-86)** |  |  |  |  |  |  |  |  |  |  |
| **95 GHz (92.0-94/94.1-100)** |  |  |  |  |  |  |  |  |  |  |

Note \* The other parameters, i.e. number of transmitters and transmitting power level, are included for fee calculation.

If there are any references about (4)Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please write it down.

|  |
| --- |
|  |

Additionally, if your answer of (5)Licensing is ‘b: light licensing’, please provide details of the method.

|  |
| --- |
|  |

## 2.2.8 Socialist Republic of Viet Nam

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Frequency band** | freq range  [GHz] | BW  [MHz] | util  (1) | trans  rate  (2) | type of  NW  (3) | No. of stations | way of assign freq  (4) | licensing (5) | fee (6) | Max trans  power[dBm] |
| **2GHz (2.010-2.690)** | 1900-2300 | 3.5/7/14 | c | a | a | 30 | a | a | b,c | 30 |
| **3 GHz (3.400-4.200)** |  |  |  |  |  |  |  |  |  |  |
| **6 GHz (5.850-7.075)** | 5.925-6425 | 29.65 | c | a,c | a | 34 | a | a | b,c | 30 |
| **7 GHz (7.075-7.900)** | 7.110-7.425  7.425-7.725 | 3.5/7/14/28  3.5/7/14/28 | a, c | a,b,c | a | 6500 | a | a | b,c | 30 |
| **8 GHz (7.900-8.500)** | 7.725-8.275  8.275-8.500 | 29.65  14/28 | a  a,c | c  a,c | a | 280  490 | a | a | b,c | 30 |
| **9 GHz (9.800-10.00)** |  |  |  |  |  |  |  |  |  |  |
| **10 GHz (10.0-10.68)** | 10.5-10.68 | 3.5/7/14/28 | c | a | a,b |  | a | a | b,c |  |
| **11 GHz (10.7-11.7)** | 10.7-11.7 | 40 | c | c | a |  | a | a | b,c |  |
| **12 GHz (11.7-12.7)** |  |  |  |  |  |  |  |  |  |  |
| **13 GHz (12.7-13.25)** | 12.75-13.25 | 3.5/7/28/56 | a,c | a,b,c | a | 800 | a | a | b,c | 27 |
| **14 GHz (14.25-14.5)** |  |  |  |  |  |  |  |  |  |  |
| **15 GHz (14.4-15.35)** | 14.5-15.35 | 3.5/7/14/28 | c | a, b,c | a | 12200 | a | a | b,c | 27 |
| **18 GHz (17.7-19.7)** | 17.7-19.7 | 20/27.5/110 | c | a,b,c | a | 570 | a | a | b,c | 23 |
| **23 GHz (21.2-23.6)** | 21.2-23.6 | 7/28/112 | c | a,b,c | a | 3100 | a | a | b,c | 23 |
| **27 GHz (24.25-29.5)** |  |  |  |  |  |  |  |  |  |  |
| **31 GHz (31.0-31.3)** |  |  |  |  |  |  |  |  |  |  |
| **32 GHz (31.8-33.4)** |  |  |  |  |  |  |  |  |  |  |
| **38 GHz (36.0-40.5)** |  |  |  |  |  |  |  |  |  |  |
| **42 GHz (40.5-43.5)** |  |  |  |  |  |  |  |  |  |  |
| **52 GHz (51.4-52.6)** |  |  |  |  |  |  |  |  |  |  |
| **57 GHz (55.78-59.0)** |  |  |  |  |  |  |  |  |  |  |
| **60 GHz (59.0-66.0)** |  |  |  |  |  |  |  |  |  |  |
| **70/80 GHz (71-76/81-86)** |  |  |  |  |  |  |  |  |  |  |
| **95 GHz (92.0-94/94.1-100)** |  |  |  |  |  |  |  |  |  |  |

(6)Licensing fee basis, please write it down:

|  |
| --- |
| The licensee has to pay the spectrum usage fee annually. The spectrum usage fee depends on frequency band and channel bandwidth.  The licensee also has to pay the application fee per license. |

Additionally, if your answer of (5)Licensing is ‘b: light licensing’, please provide details of the method.

|  |
| --- |
|  |

## 2.3 Utilization of FWS spectrum

## 2.3.1 China Mobile, China Telecom, China Unicom

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Utilization | Please provide applications  of the  Utilization | Frequency range  [GHz] | Market  trends | Product name | References  (websites/reports, etc) |
| a: transport/trunking  network |  |  |  |  |  |
| b: FWA | LTE carrier,  mobile backhaul  Small cell | 7G-42G  60GHz  80GHz | a | RTN900,RTN360,RTN380, iPasolink100/200,MINI-LINK TN、MINI-LINK CN 510, etc |  |
| c: mobile backhaul |  |  |  |  |  |
| d: temporary network |  |  |  |  |  |
| e: others |  |  |  |  |  |

## 2.3.2 Iran (Islamic Republic of)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Utilization | Please provide applications of the Utilization | Frequency range  [GHz] | Market  trends | Product name | References  (websites/reports, etc) |
| a: transport/trunking  network | Transport/  trunking  network | 7 – 86 based on Q2 table | a | Multi vendor | - |
| b: FWA | FWA such as Data transmission | 2.4, 3.3, 5.8, 24, 70 and 80 | a | Multi vendor | - |
| c: mobile backhaul | Mobile backhaul | 7 – 86 based on Q2 table | a | Multi vendor | - |
| d: temporary network | - | - | - | - | - |
| e: others | - | - | - | - | - |

## 2.3.3 Japan

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Utilization | Please provide applications of the Utilization | Frequency  range  [GHz] | Market  trends | Product name | References  (websites/  reports, etc) |
| a: transport/  trunking  network | transport/  trunking  network for telecommunications carrier | 4.9-5.0  5.03-5.091  5.925-6.425  6.570-6.870 | b | SINELINK5G  (4.9-5.0, 5.03-5.091) | http://www.hitachi-kokusai.co.jp/products/wireless/broadband/sinelink5g.html |
| b: FWA | FWA | 17.7-19.7  22.0-23.2  25.25-27.0  37.5-39.5 | a,c | PASOLINK series  (17.7-17.9, 18.45-18.72)  18C13-100 Fixed  Wireless Access  (17.7-19.7)  WIPAS  (24.05-25.445,25.557-26.453) | http://www.nec.com/en/global/prod/nw/pasolink/  http://www.toshiba.co.jp/sis/telecom/bousai/c511\_2.htm  http://www.jrcamerica.com/products/view/119 |
| c: mobile  backhaul | mobile  backhaul | 5.925-6.425  6.570-6.870  10.7-11.7  14.4-15.35  17.82-17.85/18.57-18.6  22.0-23.2  37.5-39.5  71-76/81-86 | a,c | PASOLINK series  (10.7-11.7, 14.4-15.35  17.82-17.85/18.57-18.6)  DM-1000 Series  (10.7-11.7) | http://www.nec.com/en/global/prod/nw/pasolink/ |
| d: temporary network | Disaster  recovery | 10.7-11.7  14.4-15.35  24.78-25.22  71-76/81-86 | a,c | BroadOne GX4000 Series  (71-76/81-86)  SINELIK25G  (24.78-25.22) | http://www.fujitsu.com/global/services/telecom/product/gx4000.html#id5  http://www.hitachi-kokusai.co.jp/products/wireless/broadband/sinelink25g.html |
| e: others | public and  general  services | 6.570-6.870  7.125-7.900  12.2-12.5  17.7-19.7  37.5-39.5  71-76/81-86 | c | 7C16A-208  microwave radio  (6.57-6.87 (for public))  PASOLINK series (6.570-6.870, 7.125-7.900,  12.2-12.5, 37.5-39.5)  DM-2000 Series  (6.570-6.870, 7.125-7.900,  12.2-12.5)  JUK-ZERO Series (6.570-6.870, 7.425-7.750, 12.2-12.5) | http://www.toshiba.co.jp/sis/telecom/bousai/c511\_2.htm  http://www.nec.com/en/global/prod/nw/pasolink/  http://www.jrc.co.jp/jp/product/solution/system/product/128qam/index.html |

Market trends depend on the frequency band. For example, market trends of 18GHz mobile backhaul is rapidly expanding.

## 2.3.4 Korea (Republic of)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Utilization | Please provide applications of the Utilization | Frequency range  [GHz] | Market  trends | Product name | References  (websites/reports, etc) |
| a: transport/trunking  network | P2P communication | 57-64  71-76/81-86 | a | NTE2G  ME1G | www.comotech.com |
| b: FWA |  |  |  |  |  |
| c: mobile backhaul |  |  |  |  |  |
| d: temporary network |  |  |  |  |  |
| e: others |  |  |  |  |  |

## 2.3.5 Socialist Republic of Vietnam

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Utilization | Please provide applications of the Utilization | Frequency range  [GHz] | Market  trends | Product name | References  (websites/reports, etc) |
| a: transport/trunking  network | transport/  trunking  network | below 15GHz | c | Pasolink (NEC)  Minilink (Ericsson)  Marconi LH  SAGEM | <http://www.nec.com/en/global/prod/nw/pasolink/>  <http://www.ericsson.com/ourportfolio/products/microwave-networks> |
| c: mobile backhaul | Mobile backhaul | All above | c | Pasolink (NEC)  Minilink (Ericsson)  Siae  MPR (Alcatel)  AWA  RTN (Huawei) | <http://www.nec.com/en/global/prod/nw/pasolink/>  <http://www.ericsson.com/ourportfolio/products/microwave-networks>  <http://www.huawei.com/en/products/transport-network/microwave/index.htm> |

# 3. Trends concerning standardization and regulation for FWS

## 3.1 Standardization activities concerning FWS in each country

The table below summarizes the international standardization activities of each country. The organization that handles these activities are also listed together with the standards and guidelines for fixed wireless.

|  |  |  |  |
| --- | --- | --- | --- |
| Country | Participation in international standardization activities | Organization that handles standardization, guidelines, and/or systems concerning fixed wireless | Standards, guidelines and/or systems for fixed wireless |
| Australia | ITU  APT | None | None |
| Iran (Islamic Republic of) | No | Yes. Communications Regulatory Authority | Yes. As provided by ITU Recommendations F-series and well-known standardization organizations. |
| Japan | MIC is involved in ITU and APT. Industrial organizations are involved in IEEE. | Fixed Radio Communications Division (in principle) | Yes (Ordinance Regulating Radio Equipment (Radio Regulatory Commission Rules No. 18 of 1950)and relevant regulations) |
| Korea (Republic of) | No | MSIP(Ministry of Science, ICT and Future Planning) | Rules on Radio Equipment  Technological standards for Radio Equipment |
| Singapore (Republic of) | No | None |  |
| Thailand |  | Office of The National Broadcasting and Telecommunications Commission (NBTC)  Telecommunications Standard and Technology Bureau  87 Phaholythin 8 (Soi Sailom), Samsen Nai, Phayathai, Bangkok 10400. Thailand  Tel : +66 2271 - 0151 - 60 - 654, Call Center : 1200 (Press 2)  Fax : +66 2271 - 3518 | 1. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 5 GHz )NTC. FP 106-2550(  2. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 6.7 GHz )NTC. FP 107-2550(  3. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 7.2 GHz )NTC. FP 108-2550(  4. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 7.5 GHz )NTC. FP 109-2550(  5. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 8 GHz) NTC. FP 110-2550(  6. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 11 GHz )NTC. FP 111-2550 (  7. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 15 GHz )NTC. FP 112-2550 (  8. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 18 GHz) NTC. FP 113-2550(  9. Notification of the National Telecommunications Commission  On radio frequency plan  Re: radio frequency plan for fixed service frequency range 23 GHz) NTC. FP 114-2550( |
| Socialist Republic of Vietnam | Yes, we are participating in ITU-R.  Organization: ARFM - MIC | Ministry of Information and Communication approves the technical standards, does the type approval. | Yes  Technical standards, Spectrum plan, Channel arrangement for fixed service  Ref: <http://www.mic.gov.vn>; <http://www.cuctanso.vn> |

# 4. FWS Technology trends

## 4.1 Current technology development in each country

The tables below list the frequency range, bandwidth, transmission rate and target application of countries currently conducting research and development in the fixed wireless field.

## 4.1.1 China Mobile, China Telecom, China Unicom

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency  range  [GHz] | Bandwidth  [MHz] | Transmission rate  [Mbps] | Target application |
| 1 | 71-76 GHz  81-86 GHz | 250  500  750 | 4000 | Mobile backhaul |

## 4.1.2 Iran (Islamic Republic of)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Bandwidth  [MHz] | Transmission rate  [Mbps] | Target application |
| 1 | 60 | - | - | - |
| 2 | 24.05- 24.250 | 200 | 750 | Data transport |

## 4.1.3 Japan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency  range  [GHz] | Bandwidth  [MHz] | Transmission rate  [Mbps] | Target application |
| 1 | 70/80 | 4500 | 6Gbps | Inter-building private networks,  Disaster recovery, mobile  backhaul connectivity (last-mile access link) etc |
| 2 | 90 | 5000 | 10Gbps | Fixed Wireless System with  Agile Deployment Capability  using Optical and  Millimeter-wave Communication |

## 4.1.4 Korea (Republic of)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency  range  [GHz] | Bandwidth  [MHz] | Transmission rate  [Mbps] | Target application |
| 1 | 71-76/81-86 | 5000 | 5000 | Mobile backhaul/fronthaul |
| 2 | 17.7-19.9 | 112 | 1000 | Mobile backhaul |

## 4.2 Explanation of recent trends for particular technologies (antenna, transmission methods, etc.)

The table below summarizes information about particular technologies and technology trends about fixed wireless transmission of each country.

|  |  |  |  |
| --- | --- | --- | --- |
| Country | References where there is information about  network architecture, antennas, transmission method, use of high frequencies, etc. | Plans to conduct research about  network architecture, antennas, transmission method, use of high frequencies  in fixed wireless transmission (yes/no) | Information or technology trends about fixed wireless transmission |
| China Mobile, China Telecom, China Unicom |  | yes | Frequency band ranging from 57 GHz to 64 GHz (V-BAND) is tailored for service backhaul for small cell base stations that are deployed on buildings or at the street level.  Frequency bands ranging from 71-76 GHz or 81-86 GHz (E-BAND) can provide large-capacity backhaul microwave links or aggregation links on a mobile communications network or a private network, or replace optical fibers to transmit CPRI signals between baseband units (BBUs) and remote radio units (RRUs) in a distributed base station system to achieve longer transmission of RRUs. |
| Iran (Islamic Republic of) |  |  | This administration looks for technologies which are able to enable spectrum users to utilize frequency channels in share within same geographical area, automatically. |
| Japan | AWG-16/INP-43 “Introduction of High-capacity E-band Fixed Wireless System Using Impulse Radio Technology”  AWG-16/INP-59 “ Fixed Wireless Systems Using Millimeter Wave”  http://www.toshiba.co.jp/tech/review/2011/12/66\_12pdf/f02.pdf  http://www.toshiba.co.jp/rdc/detail/1111\_01.htm  NEC TECHNICAL JOURNAL Vol.8 No.2 (April, 2014) “Development of the iPASOLINK, All Outdoor Radio (AOR) Device “, “Development of iPASOLINK Series and Super-Multilevel Modulation Technology “, “Ultra-High-Capacity Wireless Transmission Technology Achieving 10 Gbps Transmission “ | yes | Some companies develop element technology applicable to the fixed wireless systems.  For example, the transmitting and receiving filters with narrow band characteristic and low insertion loss have been developed to use a high temperature superconducting materials. |
| Korea (Republic of) | N/A | yes | N/A |
| Singapore (Republic of) | N/A | no | Nil |
| Thailand |  |  | Thailand is planning to assign frequencies in the band 71-76 GHz and 81-86 GHz (E-band). |
| Socialist Republic of Vietnam |  | yes |  |

# 5. Analysis of present demands and future usage for FWS

## 5.1 Demands for FWS based on current utilization

The tables below list the kinds of utilizations of fixed wireless systems expected in each country. In addition, the transmission rate needed and forecasted market size are also included.

## 5.1.1 China Mobile, China Telecom, China Unicom

|  |  |  |  |
| --- | --- | --- | --- |
|  | Utilization | Transmission rate  [Mbps] | Market size  (no. of stations) |
| 1 | Small cell backhaul | 500 |  |
| 2 | Instead of fiber-optic ring | 2000 |  |
| 3 | Enterprise communication | 500 |  |

## 5.1.2 Iran (Islamic Republic of)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Utilization | Transmission rate  [Mbps] | Market size  (no. of stations) |
| 1 | Transport/Trunking in fixed and mobile broadband networks | Above 200 | Multi hundreds |
| 2 | FWA access networks to home and small offices | Above 200 | Multi thousands |
| 3 | - | - | - |

## 5.1.3 Japan

|  |  |  |  |
| --- | --- | --- | --- |
|  | Utilization | Transmission rate  [Mbps] | Market size  (no. of stations) |
| 1 | Mobile backhaul for Mobile operator | 25Mbps-150Mbps | 18000 |
| 2 | Fixed Wireless Access for Telecommunications carrier | 6Mbps-150Mbps | 5400 |

## 5.1.4 Korea (Republic of)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Utilization | Transmission rate  [Mbps] | Market size  (no. of stations) |
| 1 | Mobile Backhaul | 1000 | - |
| 2 | Mobile Fronthaul | 3000 | - |

## 5.1.5 Thailand

|  |  |  |  |
| --- | --- | --- | --- |
|  | Utilization | Transmission rate  [Mbps] | Market size  (no. of stations) |
| 1 | Mobile Backhaul |  |  |
| 2 | Wireless Local Area Network |  |  |
| 3 |  |  |  |

## 5.1.6 Socialist Republic of Vietnam

|  |  |  |  |
| --- | --- | --- | --- |
|  | Utilization | Transmission rate  [Mbps] | Market size  (no. of stations) |
| 1 | transport/trunking network | N x 155 | 500 |
| 2 | mobile backhaul | 34 – 155 | 20 000 |

## 5.2 Future usage plan for FWS and consideration for possible new usages

The tables below show the planned frequency ranges, utilization and time planning of each country. The last table summarizes each countries preferable frequency range and fixed systems. The definition of the letters for the answers on ‘preferable fixed systems in own country in the future’ are listed in question 12 of the questionnaire. For quick reference, it is listed again in here.

Choices for ‘Preferable fixed systems in own country in the future’

a. Fixed wireless transmission will be the priority use.

b. Fiber-optic transmission will be the priority use if fiber-optic cable could be laid.

c. Use each method depending on purposes. (Please write examples for each use.)

d. Others (Please write examples specifically.)

## 5.2.1 Australia

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Utilization | Time planning | Plan or possibility |
| 1 | 3.4–3.6 | FWA | 2014—currently reviewing use | Possibility |

## 5.2.2 Iran (Islamic Republic of)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Utilization | Time planning | Plan or possibility |
| 1 | 24.05- 24.250 | FWA | 2014/8 assignment  2014/12 in operation | Plan |
| 2 | Some TDD LTE frequency bands (under study) | FWA to access part of networks | 2014/2015 | Plan |

## 5.2.3 Japan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Utilization | Time planning | Plan or possibility |
| 1 | 22.14-22.98  25.27-26.98  38.06-39.48 | FWA | Aug. 2014: Study  technical requirements in order to introduce  technical standards for FWA systems which  use two neighboring  frequency blocks to  transmit a carrier wave. | Possibility |

## 5.2.4 Singapore (Republic of)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Utilization | Time planning | Plan or possibility |
| 1 | 28 | Fixed services |  | Possible |
| 2 | 70/80 | Fixed services |  | Possible |

## 5.2.5 Thailand

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Utilization | Time planning | Plan or possibility |
| 1 | 71-76, 81-86 (E-band) | Mobile backhaul, Wireless local area network, etc. | 2014: regulations  2015: assignment | Plan |

## 5.2.6 Socialist Republic of Vietnam

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Frequency range  [GHz] | Utilization | Time planning | Plan or possibility |
| 1 | 60 – 70 | Transport / Backhaul | 2018 |  |

|  |  |  |
| --- | --- | --- |
| Country | Preferable frequency range for  fixed wireless transmission and its reason | Preferable fixed systems in own country in the future |
| Choice | Specifics |
| Australia | Above 6 GHz preferred for point-to-point systems. |  | Depends on circumstance, driven by geography, population density and distribution. |
| Iran (Islamic Republic of) |  | b |  |
| Japan | FWS below 6GHz can achieve over 50-km-long hop distance, and they are mainly suited for trunk/trunking network.  FWS from 10GHz to 30GHz can transmit from several km to over 10km, and they are mainly suited for various applications including mobile backhaul.  FWS over 30GHz can transmit from several hundred m to several km, and they are suited for high-capacity transmission.  In Japan, we use different ways based on the characteristics of the band. We are expanding the use of millimeter band such as 70/80GHz and developing millimeter band such as 120GHz for expanding transmission capacity because of traffic explosion and expansion of high-definition television. | c | Telecommunications carrier sometimes use wireless in rural areas because of cost. They also use wireless for backup of communication links during emergency situations.  The national government, local government and some business operators such as the power industry have fixed wireless network for communications during emergency situations or for each business use. |
| Korea (Republic of) | N/A | c | To enhance the capacity of radio access, small-cells will be more used in the future. One of the major challenges to deploying small cells is mobile backhaul and fronthaul. Mobile backhaul is the network which is connecting a base station and core network such as backbone. And, mobile fronthaul is the network connecting RRH (Remote Radio Head) and digital centralized unit such as BBU (BaseBand Unit) for effective management between cells. To install the cost-effective network consisted of small cells, not fiber-optic cable but also wireless FWS might be preferred in the area where the fiber-optic cable could not be laid due to the installation difficulty or cost.    <Wireless Mobile Backhaul/Fronthaul Concept>    <Market Trend of FWS> |
| Singapore (Republic of) | Sub 10 GHz  Higher frequencies are more susceptible to rain fade. | b |  |
| Thailand | Internationally harmonized frequency bands would be preferred because of economies of scale and availability of equipment. | c | The choice of technology will depend on each user’s requirements and circumstances. For example, fiber-optic systems will be preferred for a highly reliable transmission if fiber-optic cables could be laid, whereas fixed wireless systems may be used where fiber-optic installation is not feasible. |
| Socialist Republic of Vietnam | FWS below 15GHz can achieve long hop distance, and they are mainly suited for transport/trunking network.  FWS from 15GHz to 23GHz can transmit from several km, and they are mainly suited for mobile backhaul.  The band 18 GHz has big difficulty due to high rain attenuation level. | b | Answer is b but Fixed wireless transmission will be the priority use for the new and small mobile operators. |

# 6. Summary

This survey report summarized data collected from APT countries based on their responses to "APT SURVEY QUESTIONNAIRE ON FIXED WIRELESS SYSTEMS (AWG-16/OUT-15)" [2]. The gathered information included current usage, demand and market forecast, standardization, guidelines, future plans and research and development status for fixed wireless systems. Various enabling technologies are relied on to handle the demands for fixed wireless systems in the future.

REFERENCES

[1] WP5C, Annex 6 to Document 5C/298 “Preliminary draft new Report ITU-R F.[FS USE-TRENDS]- Fixed service use and future trends”, <http://www.itu.int/md/R12-WP5C-C-0298/en>, 28 May 2014

[2] Working Group Technology Aspects, AWG-16/OUT-15 “APT SURVEY QUESTIONNAIRE ON FIXED WIRELESS SYSTEMS” 21 March, 2014.

[3] ITU, Radio Regulations Article 5 “Frequency allocations”, 2012.

Annex: APT Survey Questionnaire on Fixed Wireless Systems

**Identification of Your Organization**

Name of the organization : <please type your answer here>

Name of contact person : <please type your answer here>

Email Address : <please type your answer here>

My organization is:

* 1. Regulator
  2. Operator
  3. Vender
  4. Other  <please describe your answer here>

**NOTE:** You do not necessarily respond to all the questions in this Questionnaire. Please provide any relevant information and your considerations as much as possible.

**Questions**

Note: Please fill in the answers on the answer sheet.

I. About the current situation in your country

1. Do you currently utilize fixed wireless systems in your country? Examples include: mobile backhaul, FWA, fixed wireless communication during emergency situations (for example, when a natural disaster strike), high-definition video transmission, and communications channel in the communications infrastructure.

If yes, answer Q2 focusing on the current status of frequency. and Q3 focusing on the application.

If no, proceed to Q4.

1. Please fill in information about the assigned frequency range, bandwidth (min, max), utilization, transmission rate, type of network, number of stations, way of assigning frequency, licensing of the different systems, licensing fee basis and maximum transmission power.

Use the letters below to answer.

1. Utilization
2. transport/trunking network (communications channel in the communications infrastructure)
3. FWA (a system that connects offices or homes directly with the provider wirelessly)
4. mobile backhaul (a communications channel that allows large amounts of data to be sent)
5. temporary network (wireless communications during emergency situations, etc.)
6. others

\*Note: Private or Public network should be categorized into “e: others”.

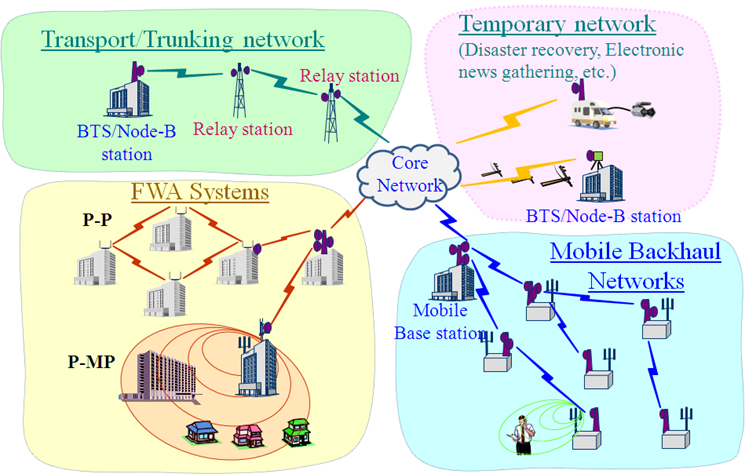


Figure: Various utilizations of fixed wireless systems

1. Transmission rate
2. below 50 Mbps
3. 51-100 Mbps
4. 101-500 Mbps
5. 501-1000 Mbps
6. 1001-2000 Mbps
7. above 2000 Mbps
8. Type of network
9. P-P Network
10. P-MP Network
11. MP-MP Network
12. Way of assigning frequency
13. first come first served
14. auction
15. assignment through comparative inspection
16. others
17. Licensing
18. individual licensing
19. light licensing (definition given by ECC Report 80)
20. license free
21. others
22. Factor of licensing fee basis (multiple answers allowed)
23. bandwidth regardless of frequency
24. frequency band
25. fee is increasing if you use multiple polarization wave
26. Location of radio stations

If there are any references about (4) Way of assigning frequency, (5)Licensing or (6)Licensing fee basis, please provide the information to the box after the Q2 answer table. Additionally, if your answer of (5) Licensing is ‘b: light licensing’, please provide details of the method.

1. Please fill in about applications, frequency range, market trends, product names and references (websites/reports, etc.) of the Utilization(1).
2. Utilization
3. transport/trunking network (communications channel in the communications infrastructure)
4. FWA (a system that connects offices or homes directly with the provider wirelessly)
5. mobile backhaul (a communications channel that allows large amounts of data to be sent)
6. temporary network (wireless communications during emergency situations, etc.)
7. others
8. Market trends
9. Expanding
10. Shrinking
11. Stable

II. Demand and market forecast

1. Will there be any demand for fixed wireless systems in your country in the future?

If yes, answer Q5. If no, proceed to Q6.

1. What kind of utilizations of fixed wireless systems do you expect in your country? Fill in about the utilization, needed transmission rate and forecasted market size (no. of stations).

III. Standardization, guidelines, systems

1. Concerning fixed wireless, are you currently participating in any kind of international standardization activity? For example, IEEE, ITU or similar standardization organizations. If you are currently active, please write the organization’s name.
2. Is there any organization in your country that handles standardization, guidelines and/or systems concerning fixed wireless? If there is, please write the organization name and contact information.
3. Are there any standards, guidelines and/or systems for fixed wireless in your country? If there are, please write the available references.

IV. Future plans

1. Do you have any plans (or possibilities) for assigning new frequency ranges for fixed wireless systems in the future? Please answer yes or no.

If yes, answer Q10. If no, proceed to Q11.

1. Please fill in about the planned (or possible) frequency ranges, utilization, and time planning.
2. If there is any preferable frequency range for fixed wireless transmission in consideration of your country’s conditions, such as geography and climate, please write it down. Also, tell us the reason for it being preferable.
3. What are your preferable fixed systems in your country in the future, fixed wireless systems or fiber-optic system or others?
4. Fixed wireless transmission will be the priority use.
5. Fiber-optic transmission will be the priority use if fiber-optic cable could be laid.
6. Use each method depending on purposes. (Please write examples for each use.)
7. Others (Please write examples specifically.)

V. Research and development

1. Are there any organizations that are currently conducting research and development in the fixed wireless field in your country?

If yes, answer Q14. and Q15. If no, proceed to Q16.

1. Please fill in about the frequency range, bandwidth, transmission rate, and target application used in the research.
2. If there are any references (reports or websites) where there is information about the research (network architecture, antennas, transmission method, use of high frequencies, etc.) please write it down.
3. In the future, do you have any plans to conduct research about network architecture, antennas, transmission method, or use of high frequencies in fixed wireless transmission in your country?

VI. Others

1. Are there any information or technology trends about fixed wireless transmission that you would like to share with the other APT members? If there are, please write it on the answer sheet.

Thank you for your cooperation!!