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|  | **Radiocommunication Study Groups** | |  |
| **INTERNATIONAL TELECOMMUNICATION UNION** | |  | |
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| **24 May 2016** | |
| **English only** | |
| Annex 3 to Working Party 5C Chairman's Report | | | |
| working document towards a preliminary draft new report itu-r f.[300GHz\_FS\_CHAR] | | | |
| Technical and operational characteristics and applications of the point-to-point fixed service applications operating in the frequency band 275-450 GHz | | | |

WRC-19 agenda item 1.15

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# 2 Scope

# 3 Related Recommendation and Report

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| Recommendation [ITU-R F.758](http://www.itu.int/rec/R-REC-F/recommendation.asp?lang=en&parent=R-REC-F.758) | System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference |
| Report ITU-R [SM.2352](http://www.itu.int/pub/R-REP-SM/publications.aspx?lang=en&parent=R-REP-SM.2352) | Technology trends of active services in the frequency range 275-3 000 GHz |

# 4 List of acronyms and abbreviations

|  |  |
| --- | --- |
| BBU | Base band unit |
| RRH | Remote radio head  … |

# 5 Definition of terahertz (THz) and others

*[Japan’s note: This section will review section 2.1 to Report ITU-R* [*SM.2352*](http://www.itu.int/pub/R-REP-SM/publications.aspx?lang=en&parent=R-REP-SM.2352) *from the point of view of the fixed service applications and technologies.]*

# 6 Regulatory information above 275 GHz

# 7 Overview of 300-GHz fronthaul and backhaul links

*[Japan’s note: This section will identify the specific frequency bands and fixed service applications, which will be, used for sharing and compatibility studies with passive services by WP 1A.]*

*[Japan’s note: This section was removed from the section 4.7 to Annex 4 to WP 5C Chairman’s Report (Doc. 5C/428) and will be revised accordingly.]*

WRC-12 agenda item 1.6 covered the review of the Radio Regulations in order to update the spectrum use by the passive services between 275 GHz and 3 000 GHz. The revised footnote 5.565 highlights that use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. It also states that administrations wishing to use the frequency range 275‑1 000 GHz for active services are urged to take all practicable steps to protect passive services from harmful interference. Subsequently, WRC-19 agenda item 1.15 invites ITU-R to identify candidate frequency bands for use by systems in the land-mobile and fixed services while maintaining protection of the passive services identified in No. [**5.565**](https://mail.google.com/mail/u/0/?ui=2&ik=5d305f97a4&view=fimg&th=154ba169905ff138&attid=0.1.1&disp=emb&attbid=ANGjdJ-NESaNRHlpXPARaDqV7VVmS29eXjpZ4bghaWR6su2eDcflPLG8o0qXps8Detx1WsI8_GRaNn1gemGXVMe-XQaXBuj3f-n90Uc4lWdmJ2QYP7H_6K_-e1OjzCs&sz=s0-l75-ft&ats=1463412491727&rm=154ba169905ff138&zw&atsh=0):

5.565 The following frequency bands in the range 275-1 000 GHz are identified for use by administrations for passive service applications:

– radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz,   
453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;

– Earth exploration-satellite service (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz.

The use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275-1 000 GHz range available for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range.

All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services.    (WRC‑12)

As of 2012, progress in semiconductor and photonic devices has enabled handling THz wave signal with a simple configuration. Oscillators and amplifiers with operating frequencies from 200 GHz to 400 GHz have been developed by using compound semiconductor technologies, such as Indium Phosphide (InP) high electron mobility transistors (HEMTs) and heterojunction bipolar transistors (HBTs). According to the International Technology Roadmap for Semiconductors (ITRS), the cut‑off frequency of silicon complementary metal–oxide–semiconductors (Si CMOS) will reach 1 THz before 2021.

One of the disadvantages of THz-wave signal is large absorption by air. Figure 1 shows the attenuation coefficient of THz waves. The attenuation coefficient of THz waves is generally larger than that in SHF and millimetre-wave region. However, the attenuation coefficient of THz waves specifically from 100 to 370 GHz is smaller than that in the 60 GHz band. Therefore, this THz band can be used for outdoor FS over a distance of several kilometres.

FIGURE 1

Attenuation coefficient of THz-waves

(Dashed line indicated attenuation coefficient at 60 GHz band)



A 300 GHz wireless link based on commercially available electronic components, such as sub‑harmonic mixers and multipliers, achieved a transmission of analogue and digital TV signals. Moreover, successful 20 Gbit/s data transmission experiments for a 300 GHz band wireless link using a photonics-based transmitter have been reported [Song, *et al.*, 2013].

# 8 System characteristics

*[Japan’s note: Technical and operational characteristics in Attachment 1 of this contribution will be included in this section, if agreed.]*

## 8.1 Characteristics for systems planned to operate in the band 275-320 GHz

The technical and operational characteristics of fixed point-to-point systems planned to operate in the band 275-320 GHz is shown in Table 1.

TABLE 1

Technical and operational characteristics of the fixed service applications planned to operate  
in the frequency band 275-320 GHz

|  |  |
| --- | --- |
| Frequency band (GHz) | 275-321.84 |
| Reference | ITU-R Report F.[300GHZ\_FS] |
| Duplex Method | FDD Editor’s note: Other duplex in schemes are possible |
| Modulation | BPSK/QPSK/16QAM/32QAM  8PSK, 8APSK  BPSK-OFDM/QPSK-OFDM/ 16QAM-OFDM/32QAM-OFDM |
| Channel spacing and receiver noise bandwidth (GHz) | 2.16/4.32/8.64/12.96/17.28//25.92/51.84/69.12[[1]](#footnote-1) |
| Tx output power range (dBW) | -30 … 10 |
| Tx output power density range (dBW/MHz) | TBD |
| Feeder/multiplexer loss range (dB) | 0 … 3 |
| Antenna gain range (dBi) | 24 … 50 |
| Antenna pattern | TBD |
| Antenna height (m) | TBD |
| e.i.r.p. range (dBW) | -6 … 60 |
| e.i.r.p. density range (dBW/MHz) | TBD |
| Receiver noise figure typical (dB) | 15 |
| Receiver noise power density typical (=*NRX*) (dBW/MHz) | TBD |
| Normalized Rx input level for 1 × 10–6 BER (dBW/MHz) | TBD |
| Nominal long-term interference power density (dBW/MHz) | TBD |
| Link length (m) | 300 … 500 |

## 8.2 Characteristics for systems planned to operate in the band [T.B.D.]

# 9 Summary

# 10 References

# 11 Annex(s) if necessary

1. The planned applications will operate in the frequency range from 252.72 to 321.84 GHz. Therefore, mentioned bandwidths may exceed the available bandwidth between 275 GHz to 321.84 GHz. [↑](#footnote-ref-1)