Radiofrequency Radiation Measurements for Public Wi-Fi Installations in Hong Kong

Office of the Communications Authority 25 October 2021

Introduction

The Office of the Communications Authority (formerly Office of the Telecommunications Authority, hereinafter collectively referred to as "OFCA") has since 2007 regularly conducted territory-wide survey of the non-ionizing radiation ("NIR) levels in the public areas due to public Wi-Fi access points ("APs"). The survey aims to gauge the abovementioned NIR levels and ensure that the NIR generated from public Wi-Fi APs does not cause exposure to the public in excess of the exposure limit recommended by the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") which is adopted by the Communications Authority ("CA"), in consultation with the Department of Health, for the protection of the public against the NIR hazards from radio transmitting equipment.

2. This report¹ presents the results of the survey conducted between July and August 2021. It is the sixth report in the series (previous ones were published in 2007, 2011, 2014, 2017 and 2019 respectively). As with the previous surveys, the latest survey results indicated that the NIR levels at the measurement locations with public Wi-Fi APs installed were well below the exposure limit recommended by the ICNIRP (the "ICNIRP limit"), ranging from less than 0.1% to 1.18% of the limit. The results tally with the finding of the World Health Organization ("WHO") that exposure levels due to Wi-Fi are generally very low. According to the WHO, there is no convincing scientific evidence that the weak radiofrequency signals from wireless networks (including Wi-Fi) would cause adverse health effects.

¹ This report contains information compiled by OFCA for reference only. Whilst OFCA endeavours to ensure that the information in this report is correct, no warranty or guarantee, express or implied, is given as to its accuracy. This report is not a substitute for medical advice. Anyone who wishes to use this report should seek expert and legal advice. The Government of the Hong Kong Special Administrative Region, the CA and OFCA accept no liability for any use reliance upon or otherwise citing this report and any part thereof.

Wi-Fi and AP

Wi-Fi

3. In this report, Wi-Fi² refers to the IEEE 802.11 group of standards operating in the 2.4 GHz and 5 GHz bands. It is a wireless broadband access technology which uses radio frequencies for linking up user terminal equipment (e.g. notebook computers, smart phones, tablets, etc.) and the broadband network for Internet access. The network device providing the Wi-Fi air interface between the broadband network and the user terminal equipment is called AP, which is a radio transceiver. The user terminal equipment has installed/built-in Wi-Fi functionality for communication with the APs.

4. Wi-Fi devices share the same frequency spectrum with many other radio apparatus, such as Bluetooth wireless devices, cordless phones and video transmitters, operating in the 2.4 GHz and 5 GHz bands. Use of these devices for private purpose is covered by an exemption order³ and no licence under the Telecommunications Ordinance (Cap. 106) is required. Provision of public Wi-Fi services in premises and locations not situated at unleased Government lands or public streets is permissible under a class licence. For provision of public Wi-Fi services on or across unleased Government land or public Wi-Fi services on or across unleased Government land or public streets, a unified carrier licence issued by the CA authorising the provision of public wireless local area network services is required.

5. According to the exemption order, the permissible peak equivalent isotropically radiated power⁴ ("e.i.r.p") in the 2.4 GHz and 5 GHz bands is 4 W. However, the transmitting power of Wi-Fi devices, including those equipment used for provision of public Wi-Fi services in the market, is generally equal to or below 0.1 W effective radiated power ("e.r.p."). Such low transmitting power of Wi-Fi devices is commensurate with the intended usage of Wi-Fi for short range communications (within 50 meters).

² Wi-Fi devices can operate in the frequency spectrum 2.4 - 2.4825 GHz ("2.4 GHz band") as well as the frequency spectrum 5.15 - 5.35 GHz, 5.47 - 5.725 GHz and 5.725 - 5.85 GHz (collectively referred to as "5 GHz band").

³ The exemption order refers to the Telecommunications (Telecommunications Apparatus) (Exemption from Licensing) Amendment Order 2021 (the "Exemption Order") which exempts a number of frequency bands from the licensing requirement. Full text of the Order is available at https://www.elegislation.gov.hk/hk/cap106Z.

⁴ Equivalent isotropically radiated power ("e.i.r.p.") refers to the power radiated from an isotropic antenna while effective radiated power ("e.r.p.") refers to the power radiated from a half-wave dipole which has a gain of 1.64 over the isotopic antenna.

APs for Public Wireless Internet Access

6. APs are radiocommunications transceivers for the provision of wireless access to Internet service and they are scattered throughout the entire territory of Hong Kong, mainly in the densely populated and built-up areas.

7. In Hong Kong, there are many APs installed in publicly accessible areas, such as shopping malls, coffee shops, restaurants, MTR stations, airport, universities, convenience stores, supermarkets, public libraries, public hospitals-and public payphone kiosks. According to OFCA's record, as of 31 August 2021, there were already over 72,594 public Wi-Fi APs installed. The information on the locations of these APs is available at: https://app2.ofca.gov.hk/apps/wifi_search/onlineEnquiry?lang=en.

NIR Limits

8. As a safety precaution to protect public health, the CA issued the "Code of Practice for the Protection of Workers and Members of Public Against Non-Ionizing Radiation Hazards from Radio Transmitting Equipment" ("CoP")⁵ in 2000. Radiocommunications service providers are required to follow the CoP and ensure that the NIR generated from their radio transmitting equipment does not cause exposure to occupational personnel and the public in excess of the ICNIRP limits laid down in the "Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz)" published in 1998 (the "ICNIRP guidelines"). The relevant NIR limits are extracted in Annex 1 for ease of reference.

9. According to the WHO, the levels of RF exposure from base stations and wireless networks (including Wi-Fi equipment) are so low that the body temperature increases due to such RF exposure are insignificant and do not affect human health. Please refer to the WHO's webpage at https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/bstations-wirelesstech for the relevant

<u>health/radiation-and-health/bstations-wirelesstech</u> for information.

⁵ The CoP is available at <u>https://www.ofca.gov.hk/filemanager/ofca/en/content_175/cop-radiation-hazards.pdf.</u>

The Survey

10. The survey was conducted between July and August 2021 at 78 selected locations with public Wi-Fi APs installed including the following types of places:

- (a) cafe, fast food shop, restaurant, convenience store, supermarket, public library, market, public park, leisure place, promenade, sightseeing spot, betting branch, bank, theatre, etc.;
- (b) public place with a large number of co-located Wi-Fi installations such as immigration control point, MTR station, ferry pier, airport, etc.;
- (c) public payphone kiosk with APs where the APs are close to users due to physical constraint of the kiosk;
- (d) public housing estate and government premises provided with public Wi-Fi services;
- (e) busy district where signals of public Wi-Fi services and those of domestic and commercial Wi-Fi installations co-exist;
- (f) educational institution; and
- (g) bus and airport express train.

Measurement Equipment and Method

<u>Measurement Equipment</u>

11. The levels of NIR from public Wi-Fi APs were measured with a professional radiation meter which is designed for measurement of aggregated NIR levels contributed from different radio transmitters in the vicinity and provides direct readout of the required 6-minute average NIR levels⁶ as required by the ICNIRP guidelines.

Measurement Method

12. The methodology of measurements on public Wi-Fi APs generally followed the widely adopted approach for NIR measurements. The measurements were carried out in areas accessible by the general public with measurement probe positioned at a height of approximately 1.7 m above ground corresponding to the head position of an average adult. The measurement results were obtained on the basis of a continued sampling of

 $^{^{\}rm 6}$ The meter reads out E-field in V/m where the unit is converted into power density in W/m 2 for ease of reference

the radio frequency signals for 6 minutes in duration. Details of the measurement procedures and methodology are set out in **Annex 2**.

The Survey Results

13. The survey results are given in **Annex 3** which showed that the NIR levels measured at the selected locations with public Wi-Fi APs installed were well below the ICNIRP limit, ranging from less than 0.1% to 1.18% of the ICNIRP limit of 10 W/m^2 .

Conclusion

14. Based on the survey results, it is concluded that the **NIR levels in** various public areas of Hong Kong, including government premises with public Wi-Fi APs installed, are well below the international exposure limit adopted by the CoP. The survey results tally with the WHO's finding that exposure levels due to Wi-Fi are generally very low. According to the WHO, there is no convincing scientific evidence that the weak RF signals from wireless networks (including Wi-Fi) would cause adverse health effects.

15. OFCA will continue to conduct regular territory-wide survey of public Wi-Fi APs to ensure that the general public exposure to NIR due to those Wi-Fi APs does not exceed the ICNIRP limit for the protection of public safety.

Office of the Communications Authority 25 October 2021

Annex 1

NIR Limits

The health protection standards specified in the CoP are those laid down in the ICNIRP guidelines. According to the ICNIRP guidelines, the limits of NIR levels applicable to Wi-Fi devices are as follows:

Reference levels for general public exposure in the frequency range of 2 – 300 GHz to time-varying electric and magnetic fields (unperturbed rms values)

Class of personnel	E-field strength (V/m)	H-field strength (A/m)	Equivalent plane wave power density (W/m ²)
General public	61	0.16	10

Measurements of NIR from Public Wi-Fi APs

Measurement Procedures

- Measurement of NIR levels is done in accordance with the following procedures:
 - (a) At each Wi-Fi hotspot location, the NIR meter is moved around in the local area to locate the maximum receivable signal strength. The first measurement will be taken at that position.
 - (b) At the measurement position, the NIR meter is positioned at a height of approximately 1.7 m (corresponds to the head position of an average adult) and continuous measurement is conducted for at least 6 minutes.
 - (c) The NIR level averaged in the 6-minute interval as read out from the meter is recorded.
 - (d) After conducting the measurement at the position identified in Step(a) which is usually close to the AP, further readings are taken sparsely within the local area where people normally stay. Steps(b) and (c) are repeated at other four sampling positions as far as the situation allows.
 - (e) The minimum and the maximum recorded NIR levels obtained in Step (c) at the measurement positions are presented in the summary table in **Annex 3**.

Results of NIR Measurements for Public Wi-Fi APs

Remarks

The NIR levels shown in the table below have nothing to do with the coverage performance of the respective APs as measurements were conducted in close proximity to the APs only. Some photos of the measurement locations are shown in the table.

		NIR	Level
Locations of APs		Measured Minimum / Maximum Power Density (W/m ²)	Measured Minimum / Maximum Power Density in term of Percentage of Exposure Limit (i.e. 10 W/m ²)
Hong Kong Island (24	4 locations)		
Wan Chai Activities Centre	Room 01, LG/F, Wan Chai Market, 258 Queen's Road East, Wan Chai, Hong Kong	0.018 / 0.076	<0.18% / 0.76%

	t 2/F, 225 Lockhart Road, Wan Chai	< 0.003	<0.03%
Cooked Food Centre			
Lee Tung Avenue	G/F Shopping Centre Public Open	<0.003 / 0.011	<0.03% / 0.11%
	Space Entrance near Amoy Street,		
	200 Queen's Road East, Wanchai, Hong Kong		

Sheung Wan Sports	11/E Shoung Wan Municipal	< 0.003	<0.03%
Centre	11/F, Sheung Wan Municipal Services Building, 345 Queen's	<0.005	<0.0570
	Road Central, Sheung Wan, Hong		
	Kong		
	Bankara A		
	T.		
Easthrides outside	Easthridge along Conneyaht Dood	0.0116 / 0.118	0.116% / 1.18%
Footbridge outside Shun Tak Centre	Footbridge along Connaught Road Central from Pedder Street to	0.0110/0.118	0.110% / 1.18%
	Shun Tak Centre		
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	G/F, Exchange Square, 8 Connaught Place, Central, Hong Kong	0.0138 / 0.0232	0.138% / 0.232%
Hong Kong City Hall	Low Block, 5 Edinburgh Place, Central, Hong Kong	<0.003	<0.03%

Aberdeen Sports Ground	108 Wong Chuk Hang Road, Aberdeen, Hong Kong	<0.003 / 0.0041	<0.03% / 0.041%
7-Eleven	Shops G & H. G/F. New Spring Garden Mansion, Nos. 47-65 Spring Garden Lane, Wanchai. Hong Kong	<0.003	<0.03%

Wanchai Law Courts	G/F, Lobby, Wanchai Tower, 12	< 0.003	<0.03%
	Harbour Road, Wan Chai, Hong		
	Kong		
Golden Bauhinia	Expo Drive, Wan Chai, Hong	0.004 / 0.0131	0.04% / 0.131%
Square	Kong		

KFC	Shop 2A-2, 2/F, Sun Hung Kai Centre, 30 Harbour Road, Wan Chai, Hong Kong	<0.003	<0.03%
Pacific Place	88 Queensway, Hong Kong	<0.003	<0.03%

Java Road Market Cooked Food Centre	2/F, Java Road Market Cooked Food Centre, 99 Java Road, North Point, HK	<0.003	<0.03%
Aldrich Bay Park	No.10 Oi Tak Street, Sai Wan Ho, Hong Kong	<0.003 / 0.0048	<0.03% / 0.048%

Wildfire Pizzabar	Shop GB02B-07, G/F, 45 Tai Hong Street, Site B, Soho East, Lei King Wan, Sai Wan Ho, Hong Kong	<0.003 / 0.0041	<0.03% / 0.041%
Hong Kong Central Library	2/F, Children's Library	<0.003	<0.03%

Hong Kong Central Library (Cont'd)	3/F, Adult Lending Library	<0.003	<0.03%
Hong Kong Central Library (Cont'd)	5/F, Current Newspaper and Periodicals Reading Area	<0.003	<0.03%

Bowrington Road Market	21 Bowrington Road, Wan Chai, Hong Kong	<0.003	<0.03%
Bowrington Road Market Cooked Food Centre (Cont'd)	1/F, 21 Bowrington Road, Wan Chai, Hong Kong	<0.003	<0.03%

Pret A Manger – Lee Gardens Two	Shop No. G12, Ground Floor, Lee Gardens Two, 28 Yun Ping Road, Causeway Bay, Hong Kong	<0.003	<0.03%
Times Square	G/F, Times Square, 1 Matheson Street, Causeway Bay, Hong Kong	<0.003 / 0.0098	<0.03% / 0.098%

PCCW payphone kiosk	Kiosk ID1301, Outside Tang Chi Ngong Clinic, Oi Kwan Road	<0.003 / 0.0118	<0.03% / 0.118%
Bank of China	213 Queen's Road East, Wan Chai, Hong Kong	<0.003 / 0.0038	<0.03% / 0.038%

HK- Macau Ferry Terminal (Inner Pier Passenger Departure Waiting Hall)	Shun Tak Centre, 200 Connaught Road, Sheung Wan	<0.003	<0.03%
The HK Jockey Club - Betting Branch	G-1/F, Malahon Apartments, 501- 515, Jaffe Road, Causeway Bay	<0.003 / 0.0138	<0.03% / 0.138%

Kowloon (25 locations Tung Chau Street Park	Tung Chau Street, Sham Shui Po	< 0.003	< 0.03%
Tung Chau Street Park Squash Centre	Tung Chau Street, Sham Shui Po, Kowloon	<0.003	<0.03%
Fung Chau Street Park Cont'd)	No. 163, Tung Chau Street, Sham Shui Po	<0.003	<0.03%

Lok Kwan Street Park	25 Lok Kwan Street, Mong Kok, Kowloon	<0.003	<0.03%
Tai Kok Tsui Market	G/F, Lobby, Wanchai Tower, 12 Harbour Road, Wan Chai, Hong Kong	<0.003	<0.03%

Kwun Chung Market Cooked Food Centre	2/F, Kwun Chung Municipal Services Building, 17 Bowring Street, Yau Ma Tei, Kowloon	<0.003 / 0.0031	<0.03% / 0.031%
Sky100 Hong Kong Ticketing Counter	Ticketing Counter, International Commerce Centre, 1 Austin Road West, Kowloon, Hong Kong	<0.003 / 0.0175	<0.03% / 0.175%

HSBC Kwun Tong Branch & Premier Centre	71 Hoi Yuen Rd, Kwun Tong	<0.003	<0.03%
Kowloon East Government Office	12 Lei Yue Mun Road, Kwun Tong	<0.003	<0.03%

APM	418 Kwun Tong Road, Kwun Tong, Kowloon	0.0039 / 0.009	0.039% / 0.09%
Tao Heung Tea House	Shop No. S150-153. 2F. Phase 1.Amoy Plaza. 77 Ngau Tau Kok Road. Kowloon	<0.003	<0.03%

Ho Man Tin Estate	Near Homantin Plaza, G/F, Yat Man House, Oi Man Estate, Ho Man Tin	<0.003 / 0.0048	<0.03% / 0.048%
The Open University of Hong Kong	30 Good Shepherd Street, Ho Man Tin	<0.003	<0.03%

Oi Man Estate	Public Rental Housing Estate Sitting-out Areas, Kar Man House, Oi Man Estate, Ho Man Tin	0.0039 / 0.0091	0.039% / 0.091%
The One	100 Nathan Road, Tsim Sha Tsui, Kowloon	<0.003	<0.03%

Hong Kong Heritage Discovery Centre	Kowloon Park, Haiphong Road, TST	<0.003	<0.03%
Pacific Coffee	Shop 4A & 4B, Promenade Level, Tower 1, China Hong Kong City, 33 Canton Road, Tsim Sha Tsui, Kowloon	<0.003	<0.03%

Hong Kong Tourism Board - Kowloon Visitor Centre	Star Ferry Concourse, Tsim Sha Tsui, Kowloon	<0.003 / 0.0042	<0.03% / 0.042%
Tsim Sha Tsui Star Ferry Pier	Star Ferry Pier, Tsim Sha Tsui, Kowloon (inside paid area)	<0.003	<0.03%

Hung Hom Promenade	At Lamppost LP27, Hung Hom (South) Ferry Pier, Kin Wan Street, Hung Hom, Kowloon	0.0104 / 0.0179	0.104% / 0.179%
Festival Walk	80 Tat Chee Avenue, Kowloon Tong, Kowloon	<0.003	<0.03%

The HK Jockey Club - Betting Branch	Shop 25, G/F, Ho King Commercial Centre, 2-16 Fa Yuen Street, Mongkok	0.0045 / 0.0078	0.045% / 0.078%
PCCW payphone kiosk	Kiosk ID 4275, Junction of Argyle Street / Peace Avenue	0.0053 / 0.0118	0.053% / 0.118%

Tung Wah College (Mongkok Campus)	Cheung Kung Hai Memorial Building, 90A, and Cheung Chin Lan Hong Building, 98, Shantung Street, Mongkok	<0.003	<0.03%
Kai Tak Cruise Terminal, Kowloon City	G/F, Custom Hall, near Hong Kong Tourism Board, Kai Tak Cruise Terminal, Kowloon City	<0.003	<0.03%

Kai Tak Cruise Terminal, Kowloon	2/F, Waiting Hall B, near escalator, Kai Tak Cruise	< 0.003	<0.03%
City (Cont'd)	Terminal, Kowloon City		
Kai Tak Cruise	2/F, North Terrace, near Shop	<0.003 / 0.014	<0.03%/0.14%
Terminal, Kowloon City (Cont'd)	N205, Kai Tak Cruise Terminal, Kowloon City		

Student Finance Office (TITKT)	Rm 403, 4/F, Student Finance Office, Trade and Industry Tower, Kai Tak, Wong Tai Sin	<0.003	<0.03%
Mikiki	Shop 119-120, L1/F, Mikiki, Kai Tak, Wong Tai Sin	<0.003	<0.03%

New Territories (24 Airport Terminal 1,	Level 5, 1 Sky Plaza Rd., Chek	< 0.003	<0.03%
HK International Airport (Level 5)	Level 5, 1 Sky Plaza Ku., Cliek Lap Kok	\U.UUJ	70.0370
Airport Terminal 1, HK International Airport (Level 7) (Cont'd)	Level 7, 1 Sky Plaza Rd., Chek Lap Kok	0.0051 / 0.0103	0.051% / 0.103%

AsiaWorld-Expo	Opposite Arena Kitchen, 1/F, Asia World Expo, Hong Kong International Airport, Lantau	<0.003	<0.03%
Pacific Coffee	Shop 243, Citygate Outlets, Tat Tung Road, 20, Tung Chung, Lantau Island	<0.003	<0.03%

Tung Chung Cable Car Terminal	11 Tat Tung Road, Tung Chung, Lantau, Hong Kong	<0.003 / 0.0039	<0.03% / 0.039%
Tuen Mun Public Library	1 Tuen Hi Road, Tuen Mun	<0.003	<0.03%

Sha Tin Public Library	1/F, Children's Library, 1 Yuen Wo Road, Shatin	<0.003	<0.03%
Sha Tin District Office -Public Enquiry Service Centre	Sha Tin Government Offices, 1 Sheung Wo Che Road, Sha Tin	<0.003	<0.03%

Hong Kong Heritage Museum	G/F, 1 Man Lam Road, Sha Tin	<0.003	<0.03%
Tsuen Wan Public Library	Tsuen Wan Government Offices, 38 Sai Lau Kok Road, Tsuen Wan	<0.003 / 0.0038	<0.03 / 0.038%

Eu Yan Sang Hong Kong	Shop 1061, Level 1, Discovery Park, 398 Castle Peak Road, Tsuen Wan, New Territories	<0.003	<0.03%
Café de Coral	2/F, Nan Fung Centre, 264-298 Castle Peak Road, Tsuen Wan	<0.003	<0.03%

Jade Garden	Shop 107, 1/F., Citywalk I, 1 Yeung Uk Road, Tsuen Wan, New Territories	<0.003	<0.03%
Circle K	G/F of No. 102B Hoi Pa Street, Cheuk Ming Building, Tsuen Wan, New Territories	<0.003	<0.03%

Standard Chartered Bank (Hong Kong) Limited	Shop C, G/F & 1/F, Jade Plaza, 298 Sha Tsui Road, Tsuen Wan, New Territories	<0.003 / 0.005	<0.03 / 0.05%
PARKnSHOP – Maritime Square	Shop 313, Maritime Square, 33 Tsing King Road, Tsing Yi, New Territories	0.0052 / 0.015	0.052% / 0.15%

Maritime Square	33 Tsing King Road, Tsing Yi	<0.003 / 0.0031	<0.03% / 0.031%
Cheung Fat Plaza	6 Tam Kon Shan Road, Tsing Yi, New Territories	<0.003 / 0.012	<0.03% / 0.12%

VanGO	Shop 202, LG2/F Shek Yam Shopping Centre, Shek Yam Estate, Kwai Chung	<0.003 / 0.0044	<0.03% / 0.044%
Kwai Tsing Theatre	12 Hing Ning Road, Kwai Chung, New Territories, Hong Kong	<0.003 / 0.0089	<0.03% / 0.089%

Starbucks Coffee	Shop 219A, Level 2, Metroplaza, 223 Hing Fong Road, Kwai Chung, New Territories	<0.003 / 0.0031	<0.03% / 0.031%
Kwai Hing Station Bus Terminus	Kwai Hing MTR Station, Kwai Hing , New Territories	<0.003 / 0.0089	<0.03% / 0.089%

Kwai Tsing District Office - Public Enquiry Service Centre	Kwai Hing Government Offices, 166-174 Hing Fong Road, Kwai Chung	<0.003	<0.03%
KMB Bus Terminus	Bus Terminus (Wah Ming Estate) Wah Ming Estate, Fanling, New Territories	<0.003	<0.03%

McDonald's	Shop P316, 3/F Kwong Fuk	0.0033 / 0.009	0.03% / 0.09%
Restaurant	Commercial Centre, Kwong Fuk	0.003370.007	0.03/0/ 0.07/0
	Estate, 28 Plover Cove Road, Tai		
	Ро		

Public Transportation (5 locations)					
City Flyer Bus (bus no. 8550)	On Board of a Citybus	<0.003	<0.03%		
Tsing Yi Station	Tierra Verde, 33 Tsing King Road	<0.003 / 0.0034	<0.03% / 0.034%		

Airport Express Train	On Board an Airport Express train	<0.003 / 0.0468	<0.03% / 0.468%
MTR Station - Austin	Concourse, Austin MTR Station	<0.003	<0.03%

MTR Station - Tai Koo	MTR Concourse - Tai Koo	<0.003	<0.03%
	<image/>		