

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

**Office of the Communications Authority
25 May 2017**

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 November 2016 and February 2017. It is the fourth report in the series (previous ones were published in 2007, 2011 and 2014 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 0.6% 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.

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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 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 in the range of equal to or below 0.1 W effective radiated power (“e.r.p.”). Such low transmitting power of Wi-Fi devices may be 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 2005 (the “Exemption Order”) which exempts a number of frequency bands from the licensing requirement. Full document of the Order is available at <http://tel.archives.ofca.gov.hk/en/ta-regulations/es22005090922.pdf>.

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 isotropic antenna.

APs for Public Wireless Internet Access

6. APs are radiocommunications transceivers for provision of wireless access of 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 March 2017, there were already over 43 320 public Wi-Fi APs installed. The information on the locations of these APs is available at: http://apps.ofca.gov.hk/apps/clr/content/public_search.asp.

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 <http://www.who.int/peh-emf/publications/facts/fs304/en/> for the relevant information.

The Survey

10. The survey was conducted between November 2016 and February 2017 at **70** selected locations with public Wi-Fi APs installed including the following types of places:

⁵ The CoP is available at http://tel_archives.ofca.gov.hk/en/code/practice/cop-radiation-hazards.pdf.

- (a) cafe, fast food shop, restaurant, convenience store, supermarket, public library, public hospital, market, public park, leisure place, promenade, sightseeing spot, betting branch, bank, cinema, etc.;
- (b) public place with a large number of co-located Wi-Fi installations such as 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, airport express train and ferry between Hong Kong and Macao.

Measurement Equipment and Method

Measurement Equipment

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 mounted on a tripod 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 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

⁶ The meter reads out E-field in V/m where the unit is converted into power density in W/m² for ease of reference

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 0.6% of the ICNIRP limit of 10 W/m².

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.

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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 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/m²)
General public	61	0.16	10

Note:

According to the ICNIRP guidelines, the E^2 , H^2 and the power density are to be averaged over any 6-minute period during measurement for frequencies between 100 kHz and 10 GHz.

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 fixed on a tripod at a height of 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.



Locations of APs		NIR Level ⁷	
		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 (27 locations)			
Fusion (by PARKnSHOP)	Kornhill Plaza (North), 1 Kornhill Road, Quarry Bay 	< 0.003 / 0.0063	< 0.03% / 0.063%
Haagen-Dazs	Shop 212, Windsor House, 311 Gloucester Road, Causeway Bay	< 0.003	< 0.03%
Circle K	10-16 Cochrane Street, Central	< 0.003	< 0.03%
VanGO	Shop 5, G/F, Causeway Centre, 28 Harbour Road, Wan Chai	< 0.003 / 0.0011	< 0.03% / 0.011%
Cityplaza	6/F, City Plaza One, Taikoo Shing 1111 King's Road, Quarry Bay	< 0.003	< 0.03%



⁷ The specified measurement range of the E-field probe is 1.3 mW/m² to 420 W/m².



PCCW Payphone Kiosk	KID 1201, outside Trust Tower, 68 Johnston Road, Wan Chai 	0.0059 / 0.0125	0.059% / 0.125%
PCCW Payphone Kiosk	KID 1208, outside Southorn Playground, Luard Road, Wan Chai	0.0098 / 0.0438	0.098% / 0.438%
Oliver's Super Sandwiches	Shop G1-B, G/F, Melbourne Plaza, 33 Queen's Road Central, Central	< 0.003	< 0.03%
Hong Kong Observation Wheel	33 Man Kwong Street, Central	0.0395 / 0.0633	0.395% / 0.633%
China Construction Bank	G/F, China Construction Bank, 3 Connaught Road Central, Central	< 0.003	< 0.03%
HK Jockey Club's Betting Branch	Shop A-D, G/F, New Spring Garden Mansion, 59-65 Spring Garden Lane, Wan Chai 	0.0033 / 0.0078	0.033% / 0.078%
Maxim's MX	1/F, The Chinese General Chamber of Commerce Building, 24-25 Connaught Road Central, Central	< 0.003	< 0.03%
Tai Wing Wah Village Cuisine	1/F, 1 Stewart Road, Wan Chai	< 0.003	< 0.03%


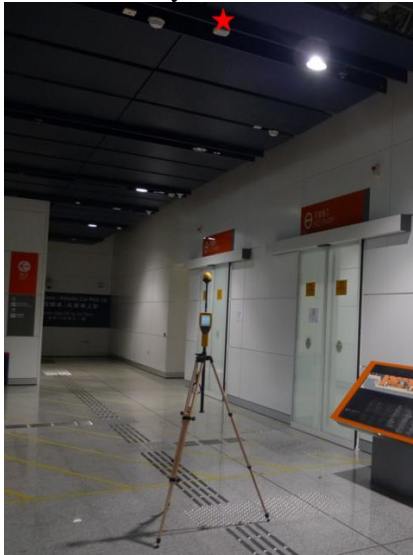
Tao Heung	Shop 104-5, 1/F, Oi Tung Shopping Centre, Oi Tung Estate, Shau Kei Wan	< 0.003 / 0.0037	< 0.03% / 0.037%
McDonald's Restaurant	3/F, McDonald's Building, 46-54 Yee Wo Street, Causeway Bay 	0.0122 / 0.0515	0.122% / 0.515%
Pret A Manger	Shop 1 and 2, Level B3, Three Pacific Place, 1 Queen's Road East, Wan Chai	< 0.003	< 0.03%
Lockhart Road Market Cooked Food Centre	2/F, 225 Lockhart Road, Wan Chai	< 0.003	< 0.03%
Vitasoy Vending Machine	Ice Palace, 1/F, City Plaza, 18 Taikoo Shing Road, Quarry Bay	< 0.003	< 0.03%
HSBC Premier	Shop 2A, 2/F, Hopewell Centre, 183 Queens Road East, Wan Chai	< 0.003	< 0.03%
Golden Bauhinia Square	Expo Drive, Wan Chai	< 0.003	< 0.03%
Victoria Park	Hard Surface Soccer Pitch (No.5), Causeway Road, Causeway Bay	< 0.003 / 0.0031	< 0.03% / 0.031%



<p>Hong Kong Central Library</p>	<p>2/F, Children's Library, 66 Causeway Road, Causeway Bay</p> 	<p>< 0.003</p>	<p>< 0.03%</p>
	<p>3/F, Adult Lending Library, 66 Causeway Road, Causeway Bay</p>	<p>< 0.003</p>	<p>< 0.03%</p>
	<p>5/F, Current Newspaper and Periodicals Reading Area, 66 Causeway Road, Causeway Bay</p>	<p>< 0.003</p>	<p>< 0.03%</p>
	<p>6/F, Young Adult Library, 66 Causeway Road, Causeway Bay</p> 	<p>< 0.003</p>	<p>< 0.03%</p>
<p>The Central Escalator Link Alley Shopping Arcade</p>	<p>2/F, Central Market, 80 Des Voeux Road Central, Central</p>	<p>< 0.003</p>	<p>< 0.03%</p>
<p>Harbour Road Sports Centre</p>	<p>G/F, Main Entrance, 27 Harbour Road, Wan Chai</p>	<p>< 0.003</p>	<p>< 0.03%</p>


			
Hong Kong Park Sports Centre	1/F, Gymnasium Entrance, 29 Cotton Tree Drive, Central 	0.0072 / 0.0115	0.072% / 0.115%
Hong Kong-Macau Ferry Terminal (Inner Pier) - Passenger Waiting Hall	Shun Tak Centre, 168-200 Connaught Road Central, Sheung Wan	< 0.003	< 0.03%
Harbour Building	38 Pier Road, Central	< 0.003	< 0.03%
Kowloon (22 locations)			
7-Eleven	Shop G01A & B, G/F, Oi Man Plaza, Hung Hom	< 0.003	< 0.03%
Pacific Coffee	Shop 26 & 27, Basement 2, Langham Place, 8 Argyle Street, Mong Kok	< 0.003	< 0.03%
Starbucks Coffee	G/F, Auditoria Building, Hong Kong Cultural Centre, 10 Salisbury Road, Tsim Sha Tsui	< 0.003	< 0.03%
West Kowloon Waterfront Promenade	West Kowloon Reclamation Area, Yau Ma Tei	< 0.003 / 0.0069	< 0.03% / 0.069%

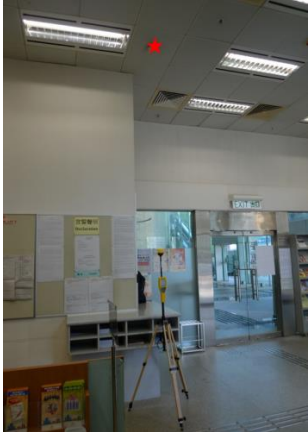


Hung Hom Promenade	Kin Wan Street, Hung Hom 	< 0.003 / 0.0046	< 0.03% / 0.046%
Kowloon Park	Near Piazza, 22 Austin Road, Tsim Sha Tsui	0.0053 / 0.0093	0.053% / 0.093%
Hong Kong Heritage Discovery Centre	Kowloon Park, Haiphong Road, Tsim Sha Tsui	< 0.003	< 0.03%
Kowloon East Government Offices	G/F, 12 Lei Yue Mun Road, Kwun Tong 	< 0.003	< 0.03%
Elements	North Entrance, Elements, 1 Austin Road West, Yua Ma Tei	< 0.003	< 0.03%
Langham Place	Langham Place, 555 Shanghai Street, Mong Kok	< 0.003	< 0.03%
Kowloon City Plaza	Shopping Mall, 128 Carpenter Road, Kowloon City	0.0053 / 0.0011	0.053% / 0.011%




KMB Bus Shelter	<p>Kowloon Park Stop, 105 Nathan Road, Tsim Sha Tsui</p> 	0.0070 / 0.0113	0.07% / 0.113%
KMB Bus Shelter	<p>East TST Railway Station Bus Stop, Salisbury Road, Tsim Sha Tsui</p>	< 0.003 / 0.0062	< 0.03% / 0.062%
Off-course betting branch of the Hong Kong Jockey Club	<p>M20, Kwun Tong Plaza, 68 Hoi Yuen Road, Kwun Tong</p>	0.0036 / 0.007	0.036% / 0.07%
Ho Man Tin Estate	<p>Lobby, G/F, Tim Man House, 68 Fat Kwong Street, Ho Man Tin, Kowloon City</p> 	< 0.003	< 0.03%
Oi Man Estate	<p>Lobby, G/F, Tun Man House, 60 Chung Hau Street, Ho Man Tin, Kowloon City</p>	< 0.003	< 0.03%


			
Bank of China	G1, Kwun Tong Plaza, 68 Hoi Yuen Road, Kwun Tong	< 0.003	< 0.03%
Kai Tak Cruise Terminal	G/F, Custom Hall, 33 Shing Fung Road, Kai Tak, Kowloon City	< 0.003	< 0.03%
			
	2/F, North Terrace, 33 Shing Fung Road, Kai Tak, Kowloon City	< 0.003 / 0.0125	< 0.03% / 0.125%
Queen Elizabeth Hospital	G/F, Block J, Queen Elizabeth Hospital, 30 Gascoigne Road, Yau Ma Tei	< 0.003 / 0.0061	< 0.03% / 0.061%

				
Yau Ma Tei Chest Clinic	2/F, 145 Battery Street, Yau Ma Tei	< 0.003	< 0.03%	
Precious Blood Hospital (Caritas)	1/F, 113 Castle Peak Road, Sham Shui Po	< 0.003	< 0.03%	
Centralfield Computer	Shop 10-16, 1/F, Golden Shopping Centre, 94 Yen Chow Street, Sham Shui Po 	0.0047 / 0.0389	0.047% / 0.389%	
New Territories (16 locations)				
Starbucks Coffee	Shop G19, City Gate, 20 Tat Tung Road, Tung Chung	< 0.003 / 0.0046	< 0.03% / 0.046%	
Luk Yeung Galleria	L1, Luk Yeung Galleria, 22-66 Wai Tsuen Road, Tsuen Wan	< 0.003 / 0.0056	< 0.03% / 0.056%	
T-Park	10/F, T-Sky, 25 Nim Wan Road, Tuen Mun	< 0.003 / 0.0030	< 0.03% / 0.030%	
	1/F, T-Hall, 25 Nim Wan Road, Tuen Mun	< 0.003	< 0.03%	
	G/F, Main Entrance, 25 Nim Wan Road,	< 0.003	< 0.03%	

	Tuen Mun		
UA Cinema	Unit 3201, 3/F, Tuen Mun Town Plaza Phase I, Tuen Mun	< 0.003	< 0.03%
New Town Plaza	4/F, Customer Service Counter, Phase 1, 18-19 Sha Tin Centre Street, Shatin	0.0070 / 0.0143	0.070% / 0.143%
Airport Terminal 1, Hong Kong International Airport	Level 5, Group Pick-up Area, 1 Cheong Tat Road, Islands	< 0.003 / 0.0046	< 0.03% / 0.046%
Airport Terminal 1, Hong Kong International Airport	Level 7, Aisle C, 1 Cheong Tat Road, Islands	< 0.003	< 0.03%
Airport Terminal 2, Hong Kong International Airport	Level 3, Gate No. 22, 1 Cheong Tat Road, Islands	< 0.003 / 0.0103	< 0.03% / 0.103%
Airport Terminal 2, Hong Kong International Airport	Level 5, Check in Counter, 1 Cheong Tat Road, Islands	< 0.003	< 0.03%
Airport Terminal 2, Hong Kong International Airport	Level 6, Aviation Discovery Ctr., 1 Cheong Tat Road, Islands	< 0.003 / 0.0045	< 0.03% / 0.045%
Lingnan University	Canteen, Tai Ning Hall, 8 Castle Peak Road, Tuen Mun	< 0.003	< 0.03%
Tsuen Wan Public Library	Tsuen Wan Government Offices, 38 Sai Lau Kok Road, Tsuen Wan 	< 0.003	< 0.03%

<p>Sha Tin District Office</p>	<p>Public Enquiry Service Centre, Sha Tin Government Offices, 1 Sheung Wo Che Road, Shatin</p> 	<p>< 0.003</p>	<p>< 0.03%</p>
<p>Kwai Tsing District Office</p>	<p>Public Enquiry Service Centre, Kwai Hing Government Offices Building, 166-174 Hing Fong Road, Kwai Chung</p> 	<p>< 0.003</p>	<p>< 0.03%</p>
<p>Sha Tin Public Library</p>	<p>1/F, Children's Library, 1 Yuen Wo Road, Sha Tin</p> 	<p>< 0.003</p>	<p>< 0.03%</p>

<p>Yuen Long Public Library</p>	<p>1/F, Children's Library, Yuen Long Government Offices, 2 Kiu Lok Square, Yuen Long</p> 	<p>< 0.003</p>	<p>< 0.03%</p>
<p>Public Transportation (5 locations)</p>			
<p>Shau Kei Wan MTR Station</p>	<p>Concourse</p>	<p>< 0.003</p>	<p>< 0.03%</p>
<p>East Tsim Sha Tsui MTR Station</p>	<p>Concourse</p> 	<p>< 0.003</p>	<p>< 0.03%</p>
<p>Airport Express Train</p>	<p>On board an Airport Express Train</p> 	<p>0.0053 / 0.0425</p>	<p>0.053% / 0.425%</p>

City Flyer Bus	On board City Flyer Bus (A11) 	< 0.003	< 0.03%
Turbo Jet	Lower Deck, Turbo Jet (Taipa)	< 0.003	< 0.03%
	Upper Deck, Turbo Jet (Universal MK2006)	< 0.003	< 0.03%