Report on

Wireless LAN War Driving Survey 2012

Hong Kong

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This report is produced for the event SafeWiFi 2012 and can be downloaded from:

http://www.safewifi.hk

Organizers

Professional Information Security Association
(PISA)
專業資訊保安協會
http://www.pisa.org.hk

Hong Kong Wireless Technology Industry Association
(WTIA)
香港無線科技商會
http://www.hkwtia.org

Sponsor

Office of the Communications Authority
(OFCA)
通訊事務管理辦公室
http://www.ofca.gov.hk

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The points made here are kept concise for the purpose of presentation. If you require details of the test and implementation, please refer to other technical references.

Report on Wireless LAN War Driving Survey 2012 Hong Kong - Editorial Board

Acknowledgements

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Photos

2012 Tramway War Driving Team – Back (Left to Right): Gretel Chan, Otto Lee, C.K. Cheng, W.S. Lam, Alan Ho, Sang Young, Eric Fan, Alan Tam, Kevin Leung, Eric Leung;
Front (Left to Right): Terry Chan, C.K. Huen, Jacky Cheng, Kenny Yiu, Frank Chow, Jim Shek, Ken Fong, Voker Lam, Michael Lo, Joseph Leung

2012 War Flying Team (Left to Right): Eric Fan, Alan Ho, Chaucer Leung, Ken Fong, Sang Young

Terms Used

WLAN	Wireless Local Area Network. There are four popular standards now: • 802.11a: using 5GHz, 54Mbps • 802.11b: using 2.4GHz, 11Mbps • 802.11g: using 2.4GHz, 54Mbps • 802.11n: using 2.4GHz or 5GHz, 300Mbps
War Driving	Collecting wireless LAN information including network name, signal strength, location, and security settings by using a device capable of WLAN signal receiver and moving from one place to another.
GPS	GPS stands for Global Positioning System. It is a "constellation" of 24 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The GPS is owned and operated by the U.S. Department of Defense but is available for general use around the world.
AP	Access Point. A device that serves as a communication “hub” for wireless clients. In SME or home, it is also referred as WLAN router.
MAC	Media Access Control address. The physical address of a Wireless LAN card.
SNR	Signal-to-Noise Ratio. A measurement of signal strength versus noise.
SSID	Service Set Identifier. The identifier name of each wireless LAN network. It is also referred as network name.
WEP	Wired Equivalent Privacy. An encryption protocol in using WLAN.
WPA	Wireless Protected Access. An improved encryption protocol over WEP in using WLAN.
WPA2	IEEE 802.11i Standard on Wireless LAN security improvement.

TKIP	Temporal Key Integrity Protocol. An encryption protocol in using WPA.
AES-CCMP	Advanced Encryption Standard - Counter Mode with Cipher Block Chaining Message Authentication Code Protocol. An encryption protocol in using WPA2.
WPS	Wi-Fi Protected Setup. It is a standard for user to setup up a secure wireless home network without understanding the details of security settings in a wireless LAN environment.

Executive Summary

In Dec 2012, the two associations **PISA** and **WTIA** jointly conducted the “War Driving 2012” field survey along the classic tramway of Hong Kong Island and 3 estates. This survey is also part of the “SafeWiFi.hk” program. The objective of this survey is to conduct a non-intrusive study on the status of Hong Kong WLAN security and arouse the public awareness in securing the use of WLAN.

The field survey was very successful. The results were benchmarked against that of the previous studies conducted by PISA and WTIA since 2002 to plot the profile of Hong Kong WLAN security development. The survey indicated that the number of WLAN implementation keeps on increasing, and yet there was some improvement in the adoption of security strategies.

The study was carried out in a non-intrusive and responsible way. The information of individual vulnerable AP was not disclosed.

PISA and **WTIA** share a common vision in promoting the use of wireless network in a productive and secure manner. They call for the public awareness of the problem. They would follow up the findings with educational programs to promote the adoption of WLAN security strategies.

The Hong Kong WLAN Security Index is increased from 67 of 2011 to **77** of 2012.

Introduction

In 2002, a team of **PISA** investigators performed the city's 1st "War Driving" study on the Wireless LAN Security Flaws in Hong Kong. It had aroused the public and corporations awareness to tighten their WLAN security loopholes. Since 2003, **PISA** and **WTIA** jointly conducted the annual "War Driving". The scope of test was extended to

- the whole tram way, covering the business corridor of the HK Island

In Dec 2012, **PISA** and **WTIA** conducted the 11th "War Driving" again to benchmark the improvement for the WLAN Security in Hong Kong. In addition, we conducted the "War Driving" at 3 types of estate in order to understand the security situation with respect to the characteristics of estates.

Since 2008, "Wireless LAN War Driving Survey" has become part of the program of "SafeWiFi.hk". More information about the "SafeWiFi.hk" program can be found in http://www.safewifi.hk.

Objectives of this Study

1. To study the current WLAN security status of Hong Kong and to benchmark the result with that of the previous year
2. To study the usage of encryption methods
3. To conduct a non-intrusive* information security study with responsible disclosure of information
4. To arouse the public awareness in WLAN security and follow up with education programs

** The study involved **neither sniffing of data nor jamming of network traffic**. The tool used was mainly for the discovery of wireless network broadcasted signals. No association with access points and no network connection were attempted during the war driving study and no data user data was captured. Every participant agreed and endorsed the Code of Ethics which is documented in the next section.*

Code of Ethics

The organizers, the reporter and all other participants agreed on the following points of the study to take care of the security and privacy issues.

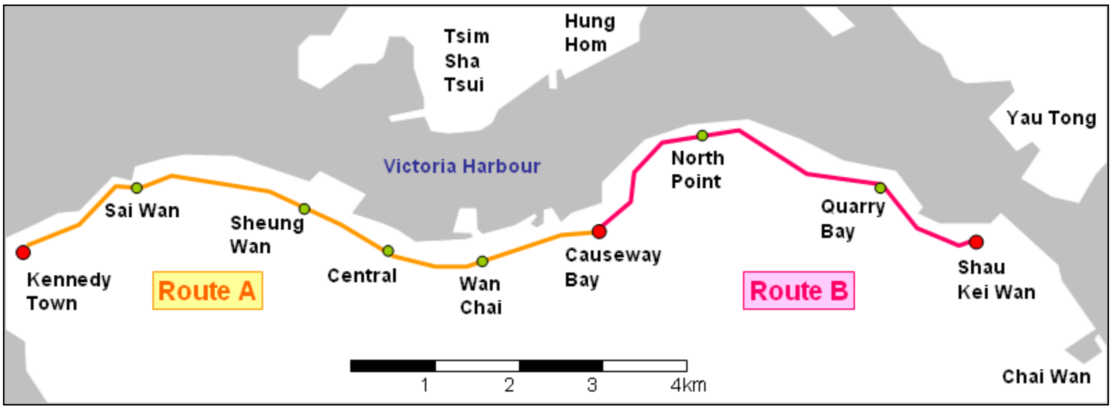
- Our objectives of the War Driving are to study the WLAN security status and compare it with the previous results, and to arouse the public awareness in WLAN security.
- We do not publicize the exact location and identity (e.g. SSID and MAC address) of any discovered AP. If such information appears in photos or other forms, it will be fully masked.
- We do not connect to the IP network of any insecure AP to further exploit its vulnerabilities.
- We do not interfere / jam any wireless traffic.
- We do not capture or collect any WLAN traffic payloads or data.
- We limit to the scope we state above only.

Methodology and Equipment

Tramway War Driving

- Tram is only available in a handful of cities around the world and tram riding is a popular activity of tourists in Hong Kong
- War Driving on a tram had been proved to be a very effective way because trams run at a moderate speed (30-50km/h) in the middle of the road, allowing a very good coverage of signals from the both sides of the road
- By War Driving on a tram, we targeted to benchmark the results with that of the war driving study conducted since year 2003 along the tramway from Kennedy Town to Shau Kei Wan. This route was equivalent to the whole business corridor of the Hong Kong Island

Details:	
Date:	2 Dec, 2012 (Sunday)
Time:	10 am – 2 pm
Equipments:	*Hardware:* • Notebook computers • WLAN cards (internal and external) • Antennae (built-in and external +12dbi) • GPS • Android Tablet/Phone *Software:* • Vistumbler for Windows 7 and Vista Platforms (http://www.vistumbler.net) • WigleWifi Wardriving for Android OS (https://play.google.com/store/apps/details?id=net.wigle.wigleandroid)
Route:	Tramway from Kennedy Town to Shau Kei Wan



Estates War Driving

This year, PISA and WTIA conducted the "War Driving" on three (3) estates in Hong Kong within the January of 2013. The objective of this exercise is to identify if any significant deviation of encryption usage by comparing to the exercise we did by using Tram.

The demographic information of these estates is as follow:

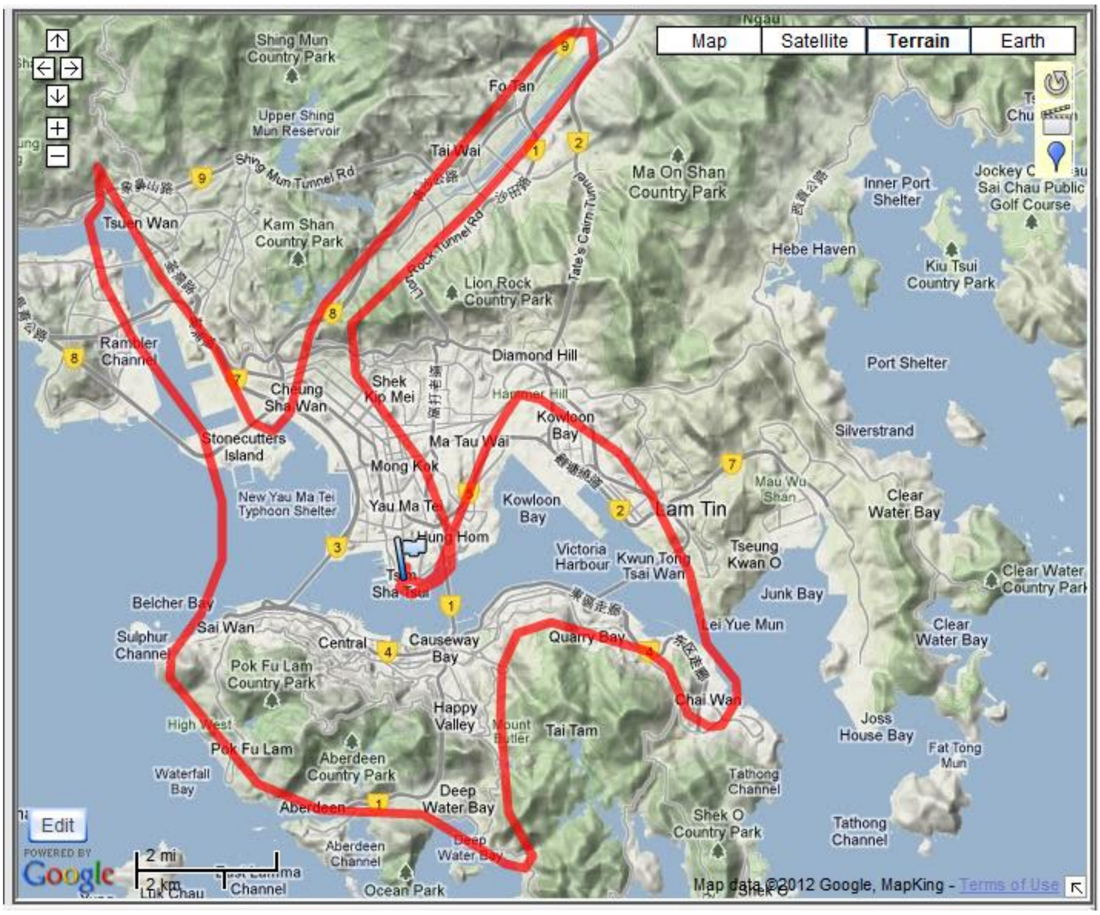
Type	Demographic Information
Estate A	• Private Housing Estate • 61 Residential Towers • Total 12,698 apartment flats • Completion since 1977 • Middle-class population
Estate B	• Home Ownership Scheme • 12 Residential Blocks • Total 4,200 apartment flats • Completion since 1993
Estate C	• Public Housing Estate • 9 Residential Buildings • Total 3,129 apartment flats • Completion since 1963

War Flying

On 20 May 2012, we conducted the first WLAN Security Survey from Air by using the

Helicopter. The objective of this exercise is to identify if any significant deviation of encryption usage by comparing to the exercise we did by using Tram. This part of Access Points cannot be recognized by using Tram and Walking in the Estates.

With the limitation of flying time of half an hour, we try to cover the area including Hong Kong Island, Kowloon and New Territories business and residential building. The flying cruise is as shown below:



Findings and Analysis - Tramway

Tramway War Driving 2012 Snapshots

Number of Access Points Captured	39,074
Access Points without using Encryption	4,400 (11.26%)
Access Points without securing the SSID *(include default SSID, SSID same as trailing hexadecimal of AP's MAC address, hotspots etc)*	2,240 (5.73%)
Access Points using 802.11b	141 (0.36%)

2012 Result Compared with Previous Years

The following table contains the result of whole tramway from year 2003 to year 2012.

Date of Test	Weather Condition	Number of Total Access Points	% of No Encryption	% of Insecure SSIDs
2 Dec 2012	Cloudy with a few rain patches	39,074	11.26% ↑	5.73% ↑
18 Dec 2011	Fine & Dry	16,618	12.12% ↑	9.09% ↑
5 Dec 2010	Sunny	16,462	13.64% ↑	13.40% ↓
26 Nov 2009	Sunny	15,753	15.50% ↑	11.57% ↑
9 Nov 2008	Trace Raining	7,388	19.26% ↑	20.41% ↑
4 Nov 2007	Sunny	6,662	27.50% ↑	30.29% ↑
15 Oct 2006	Occasional Raining	4,344	37.04% ↑	44.01% ↓
4 Dec 2005	Sunny	2,650	46.08% ↑	12.98% ↑
28 Nov 2004	Sunny	1,723	61.00% ↑	46.00% ↓
5 Oct 2003	Sunny	784	70.00%	43.00%

Legend

↑: Improved from security point of view

↓: Unsatisfied from security point of view

Highlights

1. The number of detectable deployment along the tramway, comparing with last year, drastically increases by 235%. With similar configuration of hardware to conduct the war-driving exercise, we investigate the BSSID and discovered that a lot of hotspots are installed by service providers. Their access points features multiple SSIDs.
2. The percentage of APs with encryption turned on improves by 0.86%. It is, again, slightly improved.
3. The percentage of APs with SSID secured improves by 3.36%. It is better than last year.

Encryption Usages

Vistumbler and Wifihopper allow us to run the War Driving under Vista and Windows 7 computers. The figures below cover the encryption usages break down comparing with last few years.

WEP, WPA and WPA2 Usage Distribution

	2008	2009	2010	2011	2012
Encryption Type	%	%	%	%	%
No Encryption	22.86	15.50	13.64	12.12	11.26
WEP	43.18	45.01	34.05	24.66	15.47
WPA Personal using TKIP	13.53	11.65	13.53	11.98	15.43
WPA Personal using AES	1.02	0.91	1.94	2.05	3.66
WPA Enterprise using TKIP	11.76	7.31	5.92	5.72	1.14
WPA Enterprise using AES	0.03	0.02	0.02	0.01	0.1
WPA2 Personal using TKIP	3.26	10.90	7.39	10.06	1.81
WPA2 Personal using AES	3.31	5.10	19.21	29.4	41.7
WPA2 Enterprise using TKIP	0.62	3.07	0.92	1.73	0.01
WPA2 Enterprise using AES	0.43	0.53	3.38	2.27	9.42
Total:	**100**	**100**	**100**	**100**	**100**

The usages of WEP, WPA, and WPA2 are 24.66%, 19.76% and 43.46% in year 2011 while the usages of these are 15.47%, 20.33% and 52.94% in year 2012. Although the total encryption usage is slightly improved by 0.86% only, nearly 10% are shifting to more secure methods – WPA and WPA2. It is consistent with the previous year of improvements. As a result, we have 10% usage improvement in adopting more secure methods – WPA and WPA2.

TKIP and AES Distribution

	2008	2009	2010	2011	2012
Encryption Type	%	%	%	%	%
No Encryption	22.86	15.50	13.64	12.12	11.26
WEP	43.18	45.01	34.05	24.66	15.47
WPA/WPA2 using TKIP	29.17	32.93	27.76	29.49	18.39
WPA/WPA2 using AES	4.79	6.56	24.55	33.74	54.88
Total:	**100**	**100**	**100**	**100**	**100**

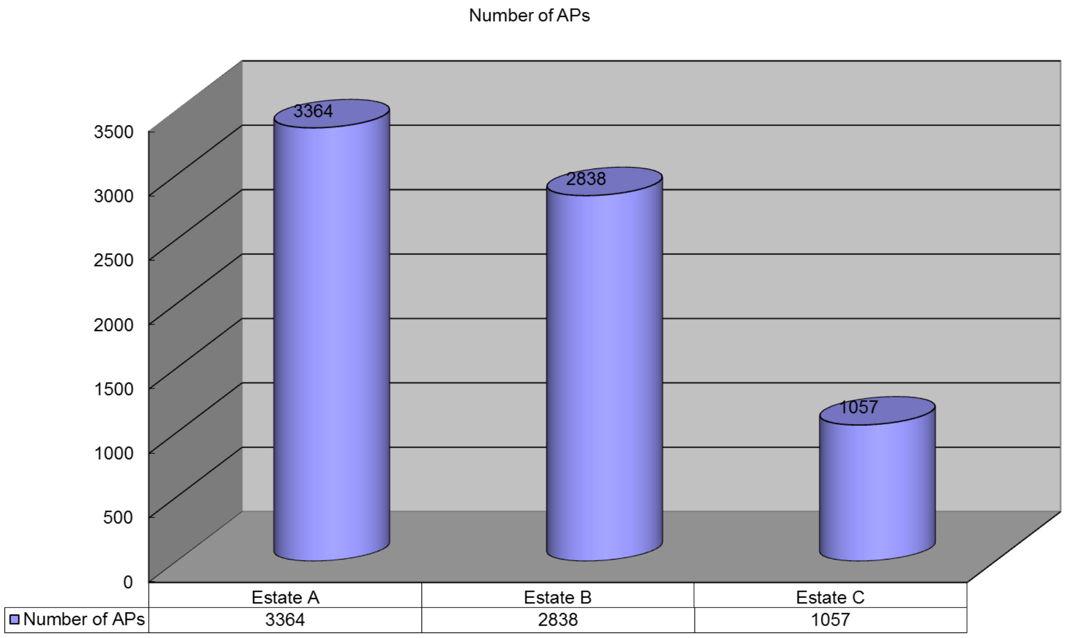
From another point of view, the adoption of more secure encryption methods (i.e. AES) increases from 33.74% to 54.88%. There is significant improvement in adopting more secure encryption methods.

WPS Usage (Experimental)

Wi-Fi Protected Setup (WPS) is a computing standard that attempts to allow easy establishment of a secure wireless home network. A major security flaw was revealed in December 2011 that affects wireless routers with the WPS feature. In this year, we also aim to indentify the potential risk of WPS by also discovering the amount of WPS turn-on on the discovered AP. However, Vistumbler cannot determine if the target Access Point enabling WPS or not. Therefore, we try to test the WPS features for the target Access Point by using “WigleWifi Wardriving for Android OS”. **The percentage of enabling WPS of total Access Points is 39.82%**.

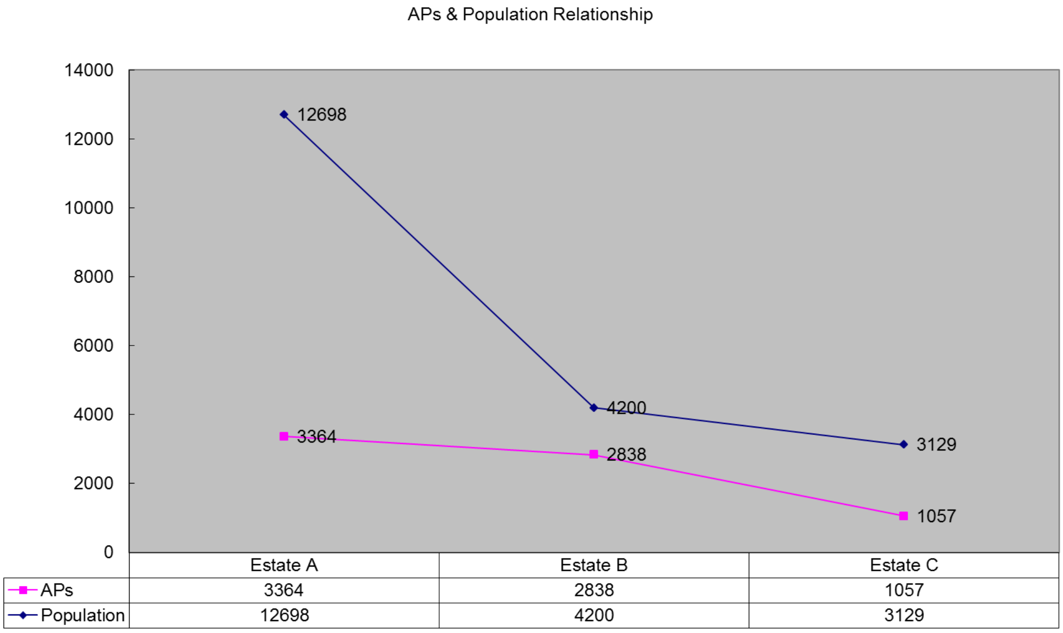
Findings and Analysis - Estates

1. Number of Unique AP Captured



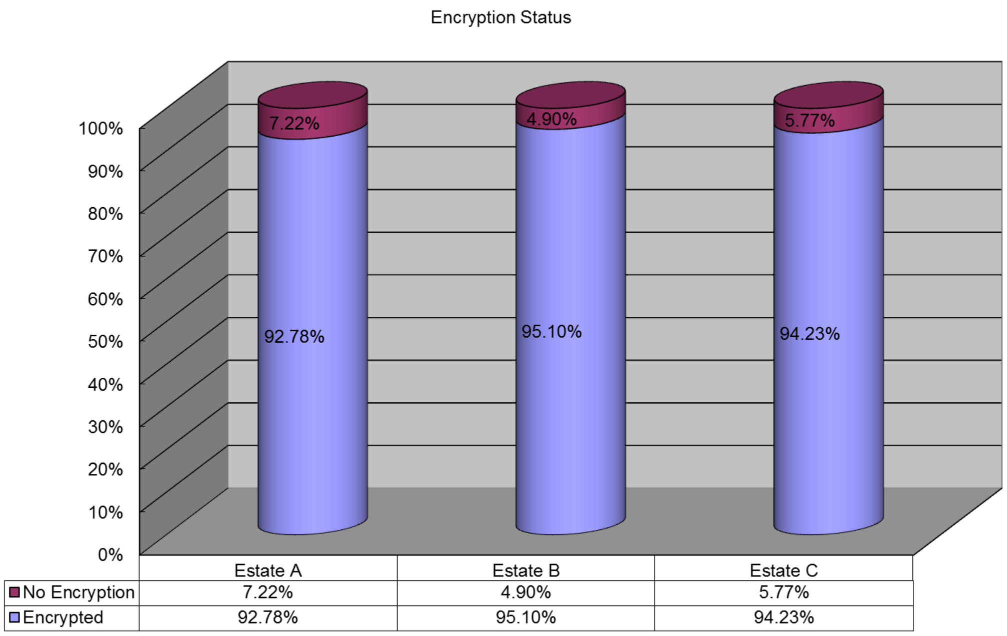
	Estate A	Estate B	Estate C
□ Number of APs	3364	2838	1057

2. Relationship between population and number of discovered Access Points



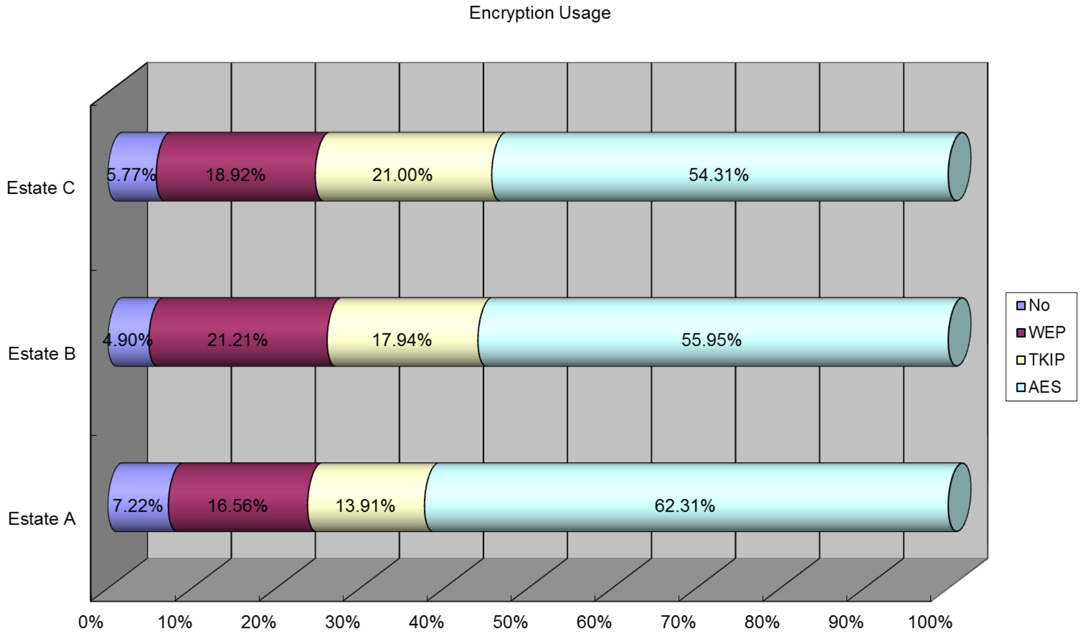
	Estate A	Estate B	Estate C
APs	3364	2838	1057
Population	12698	4200	3129

3. Encryption Status



	Estate A	Estate B	Estate C
■ No Encryption	7.22%	4.90%	5.77%
□ Encrypted	92.78%	95.10%	94.23%

4. Encryption Usage



5. Comparison with Previous Years

We did a similar exercise since year 2010. Below is the comparison in areas including the Number of Access Points, Encryption Status, and Encryption Usage.

5.1 Number of Unique Access Points Captured

	2010	2011	2012	Remarks
Estate A	3,261	2626	3364	Increase 28.10%
Estate B	1,417	1952	2838	Increase 45.39%
Estate C	382	565	1057	Increase 87.08%

5.2 Encryption Status (No Encryption)

	2010	2011	2012	Remarks
Estate A	6.75%	9.94%	7.22%	Improved by 2.72%
Estate B	9.95%	7.07%	4.90%	Improved by 2.17%
Estate C	10.99%	11.50%	5.77%	Improved by 5.73%

The number of detected access points and the use of encryption are increased this year. It is showing the trend of adoption of secure Wi-Fi networks is keep on improving this year.

5.3 Encryption Usage

	2010	2011	2012	Remarks
Estate A				
No	6.75%	9.94%	7.22%	Security Degraded ↑
WEP	34.38%	24.89%	16.56%	Security Improved ↑
TKIP	15.37%	15.87%	13.91%	Security Degraded ↑
AES	43.5%	49.30%	62.31%	Security Improved ↑
Estate B				
No	9.95%	7.07%	4.90%	Security Improved ↑
WEP	34.02%	26.54%	21.21%	Security Improved ↑
TKIP	20.32%	17.73%	17.94%	Security Improved ↓
AES	35.71%	48.66%	55.95%	Security Improved ↑
Estate C				
No	10.99%	11.50%	5.77%	Security Degraded ↑
WEP	34.55%	20.01%	18.92%	Security Improved ↑
TKIP	21.21%	16.80%	21.00%	Security Improved ↓
AES	33.25%	51.69%	54.31%	Security Improved ↑

In terms of encryption, the AES would be the best choice at this moment. The use of AES in these estates is over 50% of the total APs. It shows that there is a trend of improvements in the adoption of secure Wi-Fi networks.

Findings and Analysis – War Flying

War Flying 2012 Figures

Number of AP Captured	5,493
% of No Encryption	16.69%
Encryption Usage	
No	16.69%
WEP	20.99%
TKIP	12.34%
AES	49.98%

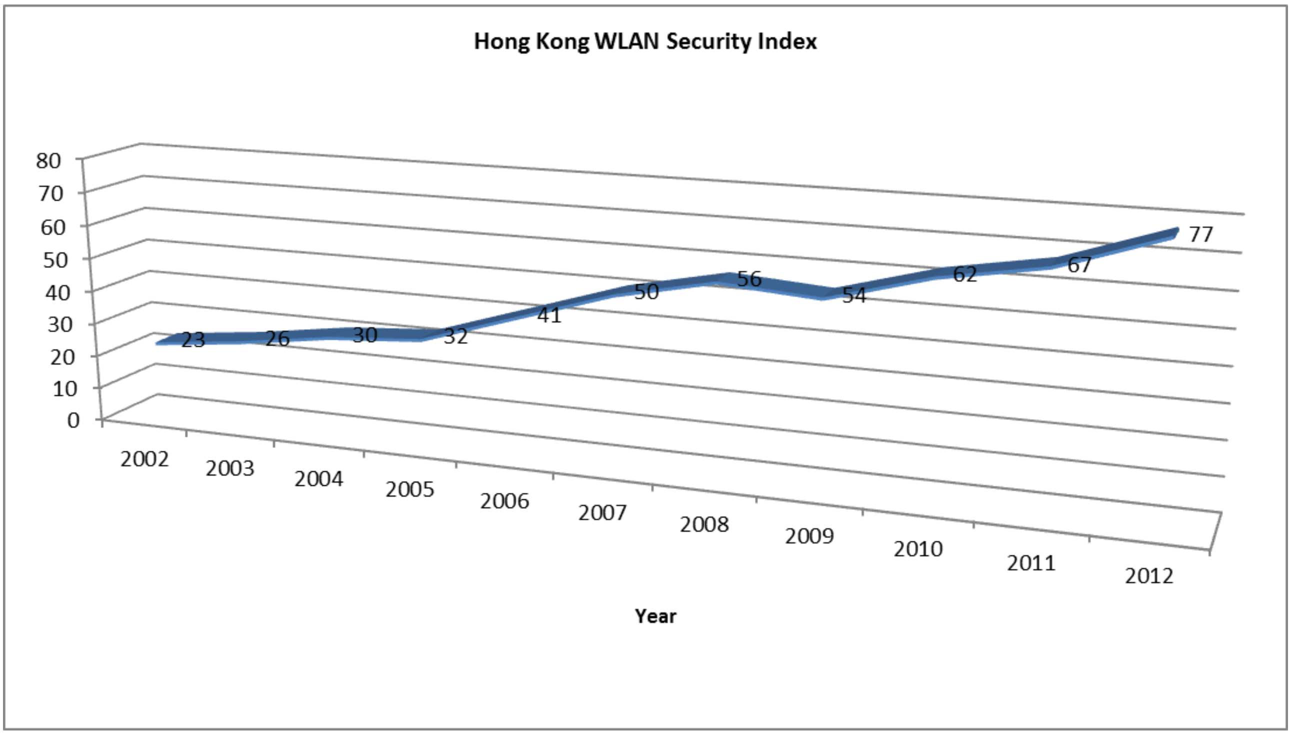
In terms of encryption, the AES would be the best choice at this moment. The use of AES is nearly 50% of the total APs. It is consistence with the figures of Tramway and Estates.

Hong Kong WLAN Security Index [香港無線網絡安全指數]

The Hong Kong WLAN Security Index is compiled by the Hong Kong Wireless Technology Industry Association (WTIA) and Professional Information Security Association (PISA), for analyzing data collected in War Driving surveys over the years.

This index takes into account the factors of the overall public awareness of encryption applied in Hong Kong, the best practice in securing the WLAN infrastructure and the technologies adopted. Every year, we review the weighting to these three factors by referring if any vulnerability discovered.

PISA and WTIA maintain this Index to keep tracking on the implementation status in WLAN security in Hong Kong. Below is the graph representing the index from 2002 to 2012:



Conclusion

Tramway War Driving

- We can see a leap in the use of encryptions whereas the overall improvement in security is improved.
- **The percentage of AP with encryption enabled is around 89 percentages.**
- For the default SSID issue, around 94% of default SSID is changed. Moreover, there are over **35%** of SSIDs **are hidden** (which is improved from previous year of 17.15%). Hidden SSID is considered as first line defense of a WLAN.
- The use of 802.11b device which may not support sophisticated encryption technologies is 0.36% which keeps on dropping.
- **The percentage of AP with WPS enabled is around 40 percentages**. There is known security vulnerability in WPS. It shows that around **40% of WLANs are subjected to this attack**.

Encryption Usages

- In recent year, WEP cracking methods are enhanced. It allows an intruder to penetrate to a WLAN using WEP cracking within 10 minutes of time. In our study, 15.47% of WLANs are still using WEP. Although there is a large percentage improvement, **we are still not satisfied with this figure as the latest technologies are outdated for more than 7 years**.
- The adoption of WPA/WPA2 is improved **over 73%**. It shows the adoption of more secure encryption methods is increasing.
- In year 2008, there is a way to crack WPA using TKIP as an encryption algorithm. In our study, 18.39% of WLANs are using TKIP. It drops by 11.10% comparing with year 2011. Significant improvement was recorded in this year.
- The adoption of more secure encryption methods – AES is increased from 33.73% to 54.88%. **It shows that over 50% of Access Points are using the most secure encryption methods**.

Estate War Driving

- Number of discovered APs is directly related to the number of population.
- The percentage of using AES encryption is over 50% this year in our sampled three estates.
- The adoption of most secure encryption method is aligned with the survey using Tram and Helicopter.

War Flying

- The percentage of using AES encryption is nearly 50% which is aligned with the other survey methods.

Hong Kong WLAN Security Index

- The Hong Kong WLAN Security Index of 2012 is 77 while the index of 2011 is 67. It shows some improvements in WLAN security implementation are found in Hong Kong.