



# Sharing Session on HKIEd Wi-Fi Services and Useful Tips

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# Agenda

- HKIEd's Wi-Fi Deployment History
- Current HKIEd's Wi-Fi Deployment
- Recent Changes
- HKIEd's SSIDs
- Wi-Fi Network Topology
- Wi-Fi Basic Concept
- Wi-Fi Limitations



# Agenda (cont'd)

- Wi-Fi Security
- Challenges
- Recent Wi-Fi Usage
- Wi-Fi Troubleshooting
- Tips for using Wi-Fi in HKIEd
- Some tools for troubleshooting
- Future
- Q & A



# HKIEd's Wi-Fi Deployment History

- Cisco “Fat” APs in Campus ( before 2006 )
- Aruba “Thin” APs in Town Center ( 2006 )
- Aruba “Thin” APs in Main Campus ( 2007 )
- Cisco “Thin” APs in Hostel ( 2010 )





# HKIEd's Wi-Fi Deployment History (I)

## Cisco "Fat" APs in Campus ( before 2006 )

- Supports 802.11b only
- Supports OPEN or WEP only
- Supports 1 SSID per AP
- Hard to manage
- Installed Temporarily
- Installation as per-request basis
- Poor roaming capabilities



## HKIED's Wi-Fi Deployment History (II)

Aruba "Thin" APs in Town Center ( 2006 ) and Main Campus ( 2007 )

- Supports 802.11a/b/g ( Max 54Mbps ) 
- Supports OPEN, WEP, WPA ( TKIP ) and WPA2 ( AES )
- Supports Multiple SSIDs
- Centralized Management
- Permanent Installation
- Better roaming capabilities



# HKIEd's Wi-Fi Deployment History (III)

## Cisco "Thin" APs in Hostel ( 2011 )

- Supports 802.11a/b/g/n ( Max 300Mbps ) 
- Supports OPEN, WEP, WPA ( TKIP ) and WPA2 ( AES )
- Supports Multiple SSIDs
- Centralized Management
- Permanent Installation
- Better roaming capabilities



# Current HKIEd's Wi-Fi Deployment

- More than 700 APs installed to both Main Campus ( ~ 350 APs ) and Hostel ( ~ 350 APs )
- Some main campus areas support 802.11a/b/g/n – Learning common, Canteen, Library
- Some main campus and Hostel areas support “Spectrum analysis” – not only monitor Wi-Fi signal



# Recent Changes (I)

- Upgraded our Aruba controllers for Main Campus to support 802.11n APs
- Added dedicated 300Mbps Link ( via HKBN ) for hostel wired and wireless users
- Reduced no. of SSIDs in Main Campus and Hostel
- Changed hostel's SSIDs to "Hostel" and "HostelGuests"



## Recent Changes (II)

- Fine-tune transmission power ( Tx ) to reduce co-channel interference
- Increased “Arp cache” to support more users in firewall
- Removed lower data rate support ( 1Mbps, 2Mbps and 5.5Mbps )
- Enabled “Band Steering/Select” to help wireless clients to use 802.11a/an ( 5GHz )



## Recent Changes (III)

- Removed “Rogue” APs in some area such as Pacific Coffee, MIT which might interfere with our signal
- Installed airwave to locate “Rogue” APs and for clients troubleshooting

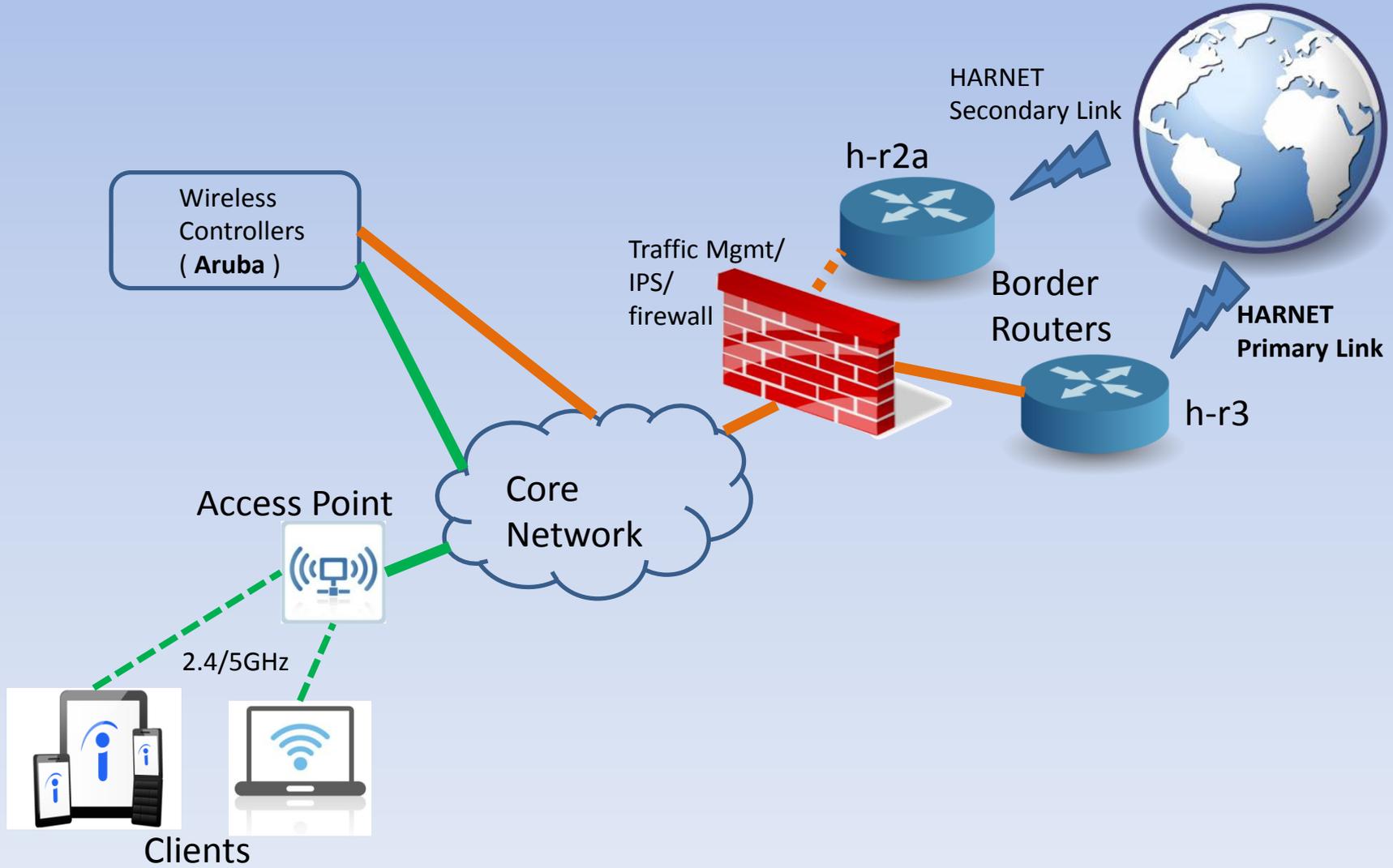


# HKIED's SSIDs

SSID	Location	Encryption	Authentication
HKIED	All Main Campus Area	WPA(TKIP)/WPA2(AES)	802.1x
HKIEDGuests/VPN	All Main Campus Area	OPEN	Captive Portal
eduroam	All Main Campus Area	WPA(TKIP)	802.1x
Universities WiFi	Only G/F Main Campus Area	WPA(TKIP)/WPA2(AES)	802.1x
PCCW	Only G/F Main Campus Area	OPEN	Captive Portal
PCCW1x	Only G/F Main Campus Area	WPA(TKIP)/WPA2(AES)	802.1x
Y5ZONE	Only G/F Main Campus Area	OPEN	Captive Portal
Hostel	All Hostel Area	WPA(TKIP)/WPA2(AES)	802.1x
HostelGuests	All Hostel Area	OPEN	Captive Portal

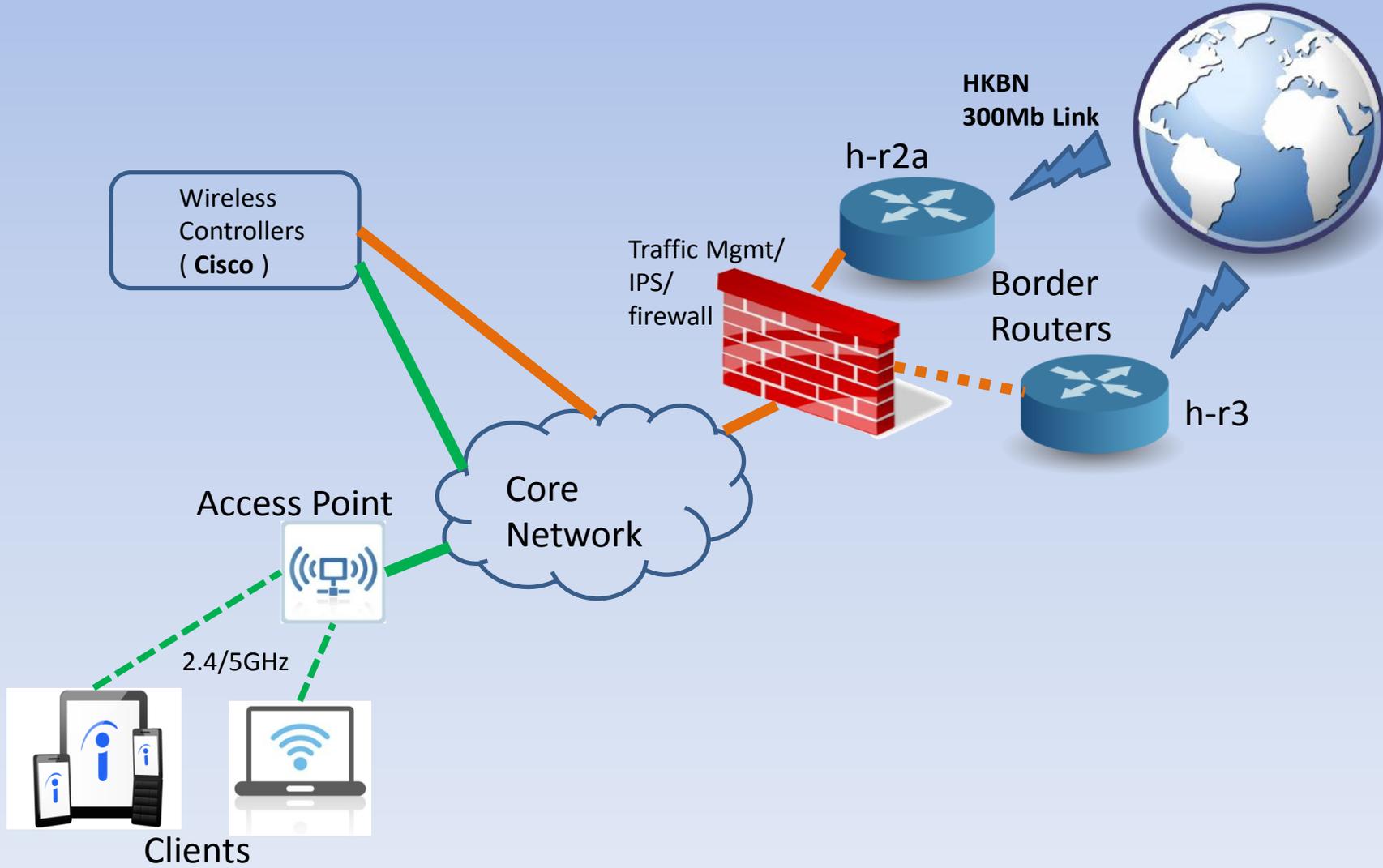


# Wi-Fi Network Topology (Main Campus)





# Wi-Fi Network Topology (Hostel)

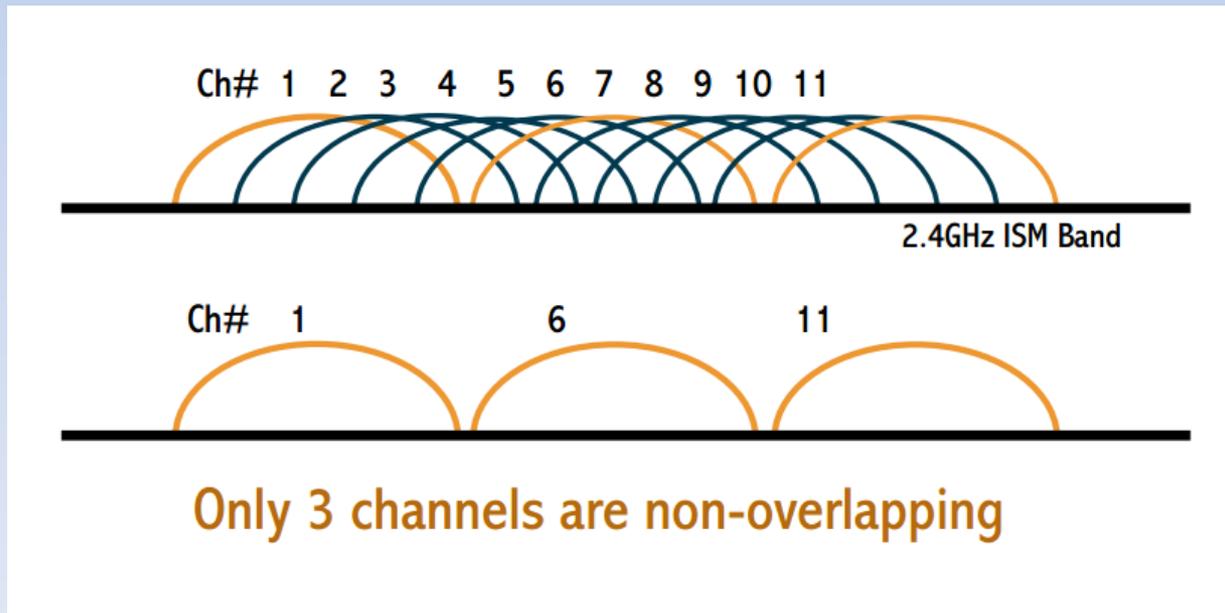




# Wi-Fi Basic Concept (I)



- Channel 2.4GHz band (only 3 channels have non-overlapping frequency )

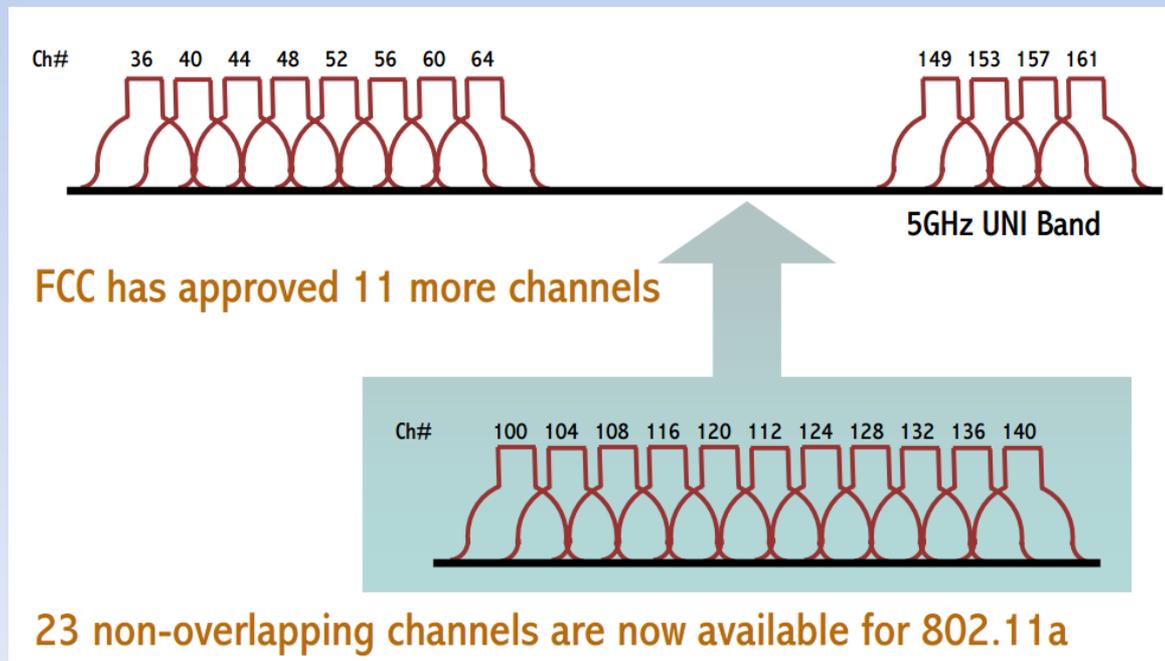




# Wi-Fi Basic Concept (II)



- Channel 5GHz band ( 23 channels have non-overlapping frequency )





# Wi-Fi Limitation (I)

Some things you might need to know:-

- “**DATA RATES**” quoted in the Wi-Fi specifications refer to the raw radio symbol rate, **NOT** the actual TCP/IP throughput rate. The rest is called protocol overhead.
- A good rule of thumb: the practical TCP/IP throughput is about **HALF** the data rate. For example, a 54 Mbps 802.11a link has a maximum practical throughput of roughly 25 Mbps.



# Wi-Fi Limitation (II)

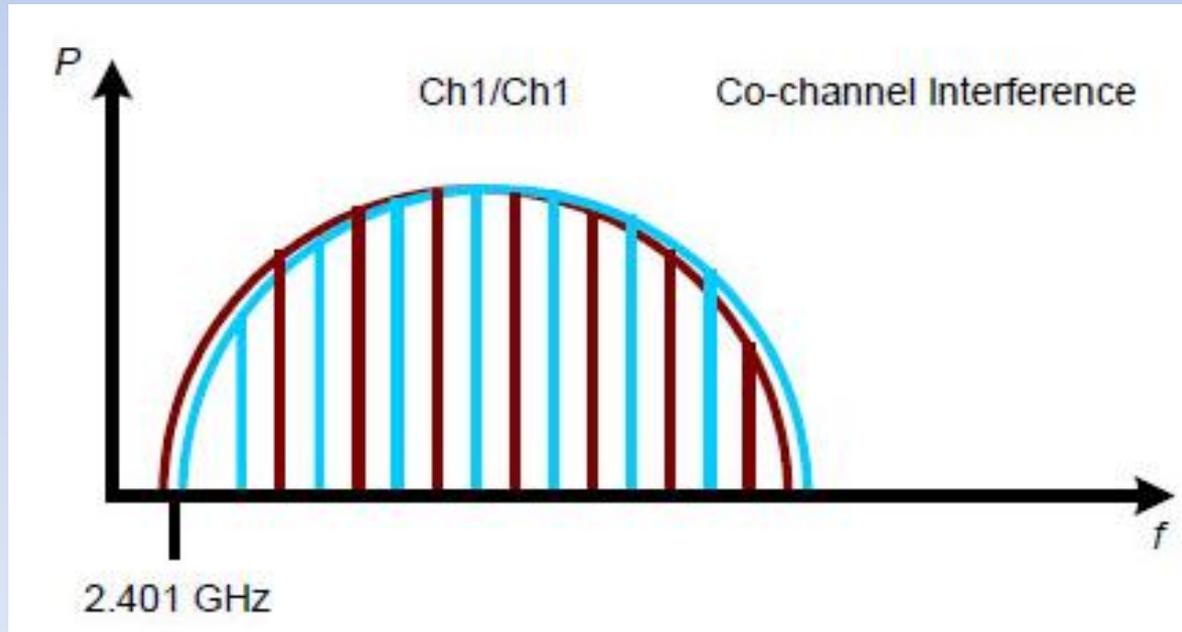
## Type of Interferences

- Co-Channel Interference (CCI)
- Adjacent Channel Interference (ACI)



# Wi-Fi Limitation (III)

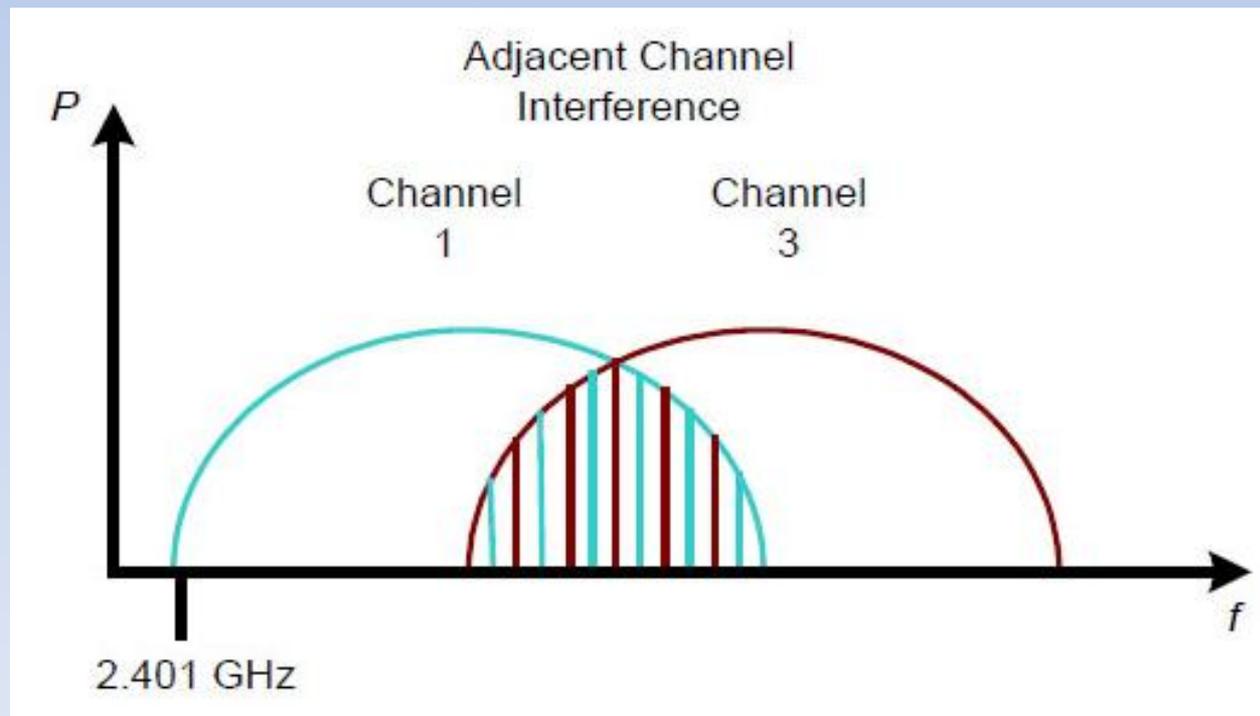
## Co-Channel Interference (CCI)





# Wi-Fi Limitation (IV)

## Adjacent Channel Interference (ACI)





# Wi-Fi Limitation (V)

## Non-Wi-Fi Interference Sources





# Wi-Fi Security (I)

Implement the following safeguards

- Ensure your operating system is fully patched
- Verify antivirus software has latest virus definition updates
- Update 3<sup>rd</sup> party software ( like Adobe reader and MS Office )



## Wi-Fi Security (II)

- Avoid to connect “OPEN” ssid in public area
- Avoid to connect “UNKNOWN” ssid
- Select better wireless network that use some form of encryption ( WPA2/ WPA/ WEP )
- HTTPS/SSL
- Avoid to do any kind of banking activity/ financial transaction while connected to a **PUBLIC** hot spot



# Challenges (I)

- Upgrading every Wi-Fi access point to support 802.11n in the 2.4 and 5 GHz band in main campus
- Continuing to expand the number of access points in high user areas to help alleviate wireless congestion
- Deploying access points that are capable of detecting interference from outside sources

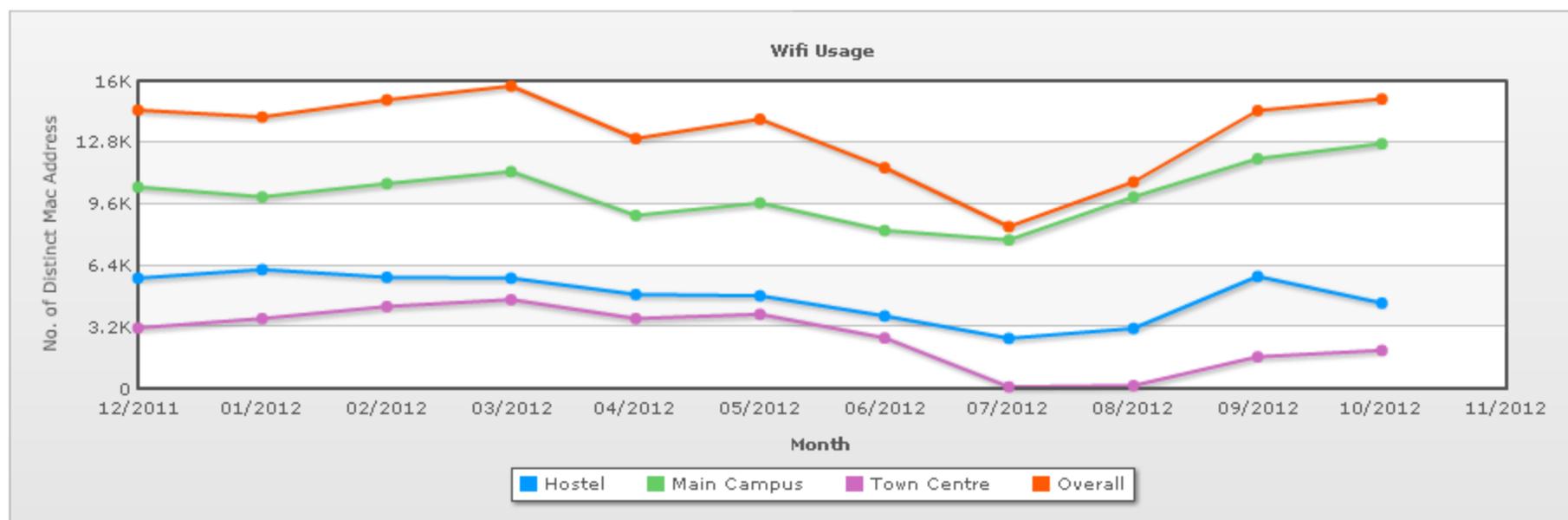


## Challenges (II)

- continuing to work with our wireless vendor (Aruba and Cisco) to improve our wireless services
- maintaining close a relationship with our Departments in order to continue to improve wireless service to staff and students
- performing through Wi-Fi capacity and coverage assessment surveys periodically to ensure the appropriate deployment of wireless access points



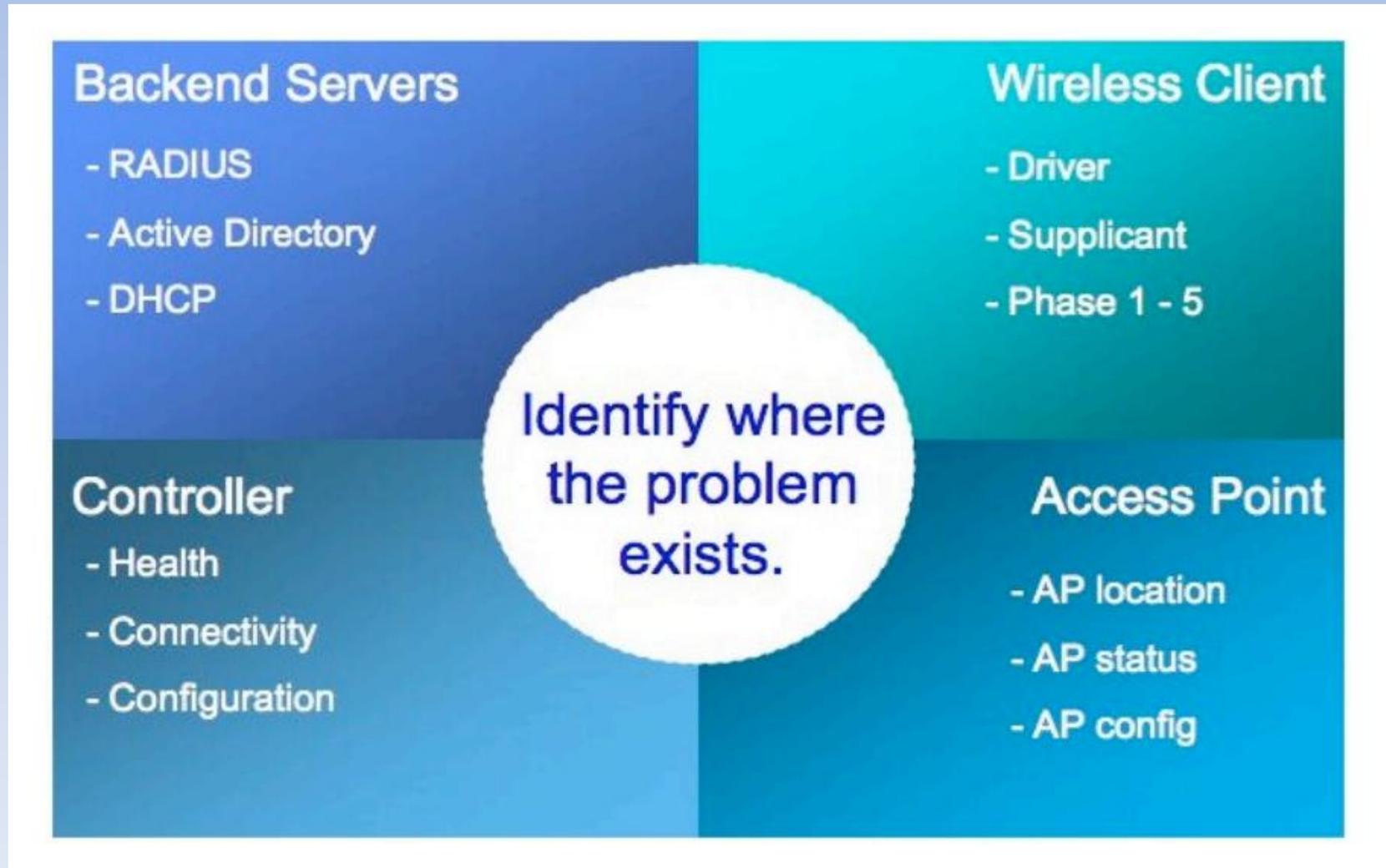
# Recent Wi-Fi Usage



	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012	10/2012	11/2012
Hostel	5749	6197	5778	5749	4901	4821	3778	2612	3123	5825	4448	---
Main Campus	10471	9958	10653	11289	8993	9661	8229	7728	9968	11950	12736	---
Town Centre	3140	3643	4276	4619	3648	3872	2636	96	161	1648	1992	---
Overall	14488	14119	15024	15734	13009	14003	11493	8427	10739	14459	15069	---



# Wi-Fi Troubleshooting (I)





# Wi-Fi Troubleshooting (II)

## User Issues

- Can't see SSID
- Can't associate
- Can't authenticate
- Limited internet access
- Poor performance
- Dropped connections



# Wi-Fi Troubleshooting (III)

Can' t see SSID

- Outside the coverage of an AP?
- AP down?
- Connected to LAN?
- Manual disable wireless interface?
- Driver issue?



# Wi-Fi Troubleshooting (IV)

Can' t associate

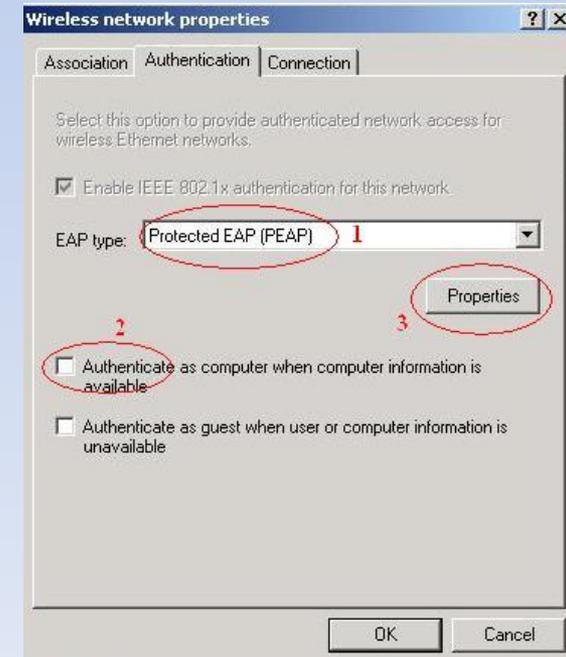
- Wrong setting? ( OPEN, WEP, WPA, WPA2 )
- Rogue AP?



# Wi-Fi Troubleshooting (V)

Can't authenticate

- Wrong user name?
- Wrong Authentication Method?
- Wrong password?
- Changed password?





# Wi-Fi Troubleshooting (VI)

Limited internet access

- Hardcoded IP address?
- IP used up?
- DHCP server down?



# Wi-Fi Troubleshooting (VII)

Poor performance

- Interference?
- Too many users?



# Wi-Fi Troubleshooting (VIII)

Dropped connections

- Driver not update?



# Some tools for troubleshooting (I)

- Wi-Fi Analyzer ( Android )
- inSSIDer ( WinXP/Vista/Win7 )
- [speedtest.ofca.gov.hk](http://speedtest.ofca.gov.hk)
- ping ( Notebook/Netbook/Desktop )



# Some tools for troubleshooting (II)

## Wi-Fi Analyzer ( Android )





# Some tools for troubleshooting (III)

## inSSIDer ( WinXP/Vista/Win7 )



inSSIDer 2.1

File View Help Start GPS Intel(R) Centrino(R)...

FILTER  Channel Network Type Security ?

MAC Address	SSID	RSSI	Chann	Vendor	Security	Max Rate	Network Type	First Seen	Last Seen	Latitude	Longitude
00:0B:86:4D:0E:02	PCCW	-71	11	Aruba Networks	Open	54	Infrastructure	2:39:39 PM	2:39:58 PM	0.000000	0.000000
00:0B:86:4D:0E:03	HKIED	-69	11	Aruba Networks	WPA2-Enterpri...	54	Infrastructure	2:39:39 PM	2:39:52 PM	0.000000	0.000000
00:0B:86:4D:0E:04	Y5ZONE	-71	11	Aruba Networks	Open	54	Infrastructure	2:39:39 PM	2:39:58 PM	0.000000	0.000000
00:0B:86:4D:0E:05	PCCW1x	-69	11	Aruba Networks	WPA2-Enterpri...	54	Infrastructure	2:39:39 PM	2:39:58 PM	0.000000	0.000000
00:0B:86:4D:40:20	eduroam	-76	6	Aruba Networks	WPA-TKIP	54	Infrastructure	2:39:39 PM	2:39:58 PM	0.000000	0.000000
00:0B:86:4D:40:24	Y5ZONE	-74	6	Aruba Networks	Open	54	Infrastructure	2:39:39 PM	2:39:58 PM	0.000000	0.000000
00:0B:86:4D:0E:06	Universities WiFi	-70	11	Aruba Networks	WPA2-Enterpri...	54	Infrastructure	2:39:39 PM	2:39:58 PM	0.000000	0.000000
00:0B:86:4D:3B:08	eduroam	-68	40	Aruba Networks	WPA-TKIP	54	Infrastructure	2:39:39 PM	2:40:03 PM	0.000000	0.000000

Improve Your Wi-Fi Time Graph 2.4 GHz Channels 5 GHz Channels GPS

Amplitude [dBm]

57 / 57 AP(s) CPS: Off Logging: Off

Desktop 100% ENG 2:40 PM 8/28/2012



# Some tools for troubleshooting (IV)

[speedtest.ofca.gov.hk](http://speedtest.ofca.gov.hk)





# Some tools for troubleshooting (V)

## “Ping”

```
C:\>ping www.google.com.hk
```

```
Pinging www.google.com.hk [74.125.128.106] with 32 bytes of data:
```

```
Reply from 74.125.128.106: bytes=32 time=405ms TTL=50
```

```
Reply from 74.125.128.106: bytes=32 time=412ms TTL=50
```

```
Reply from 74.125.128.106: bytes=32 time=401ms TTL=50
```

```
Reply from 74.125.128.106: bytes=32 time=409ms TTL=50
```

```
Ping statistics for 74.125.128.106:
```

```
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

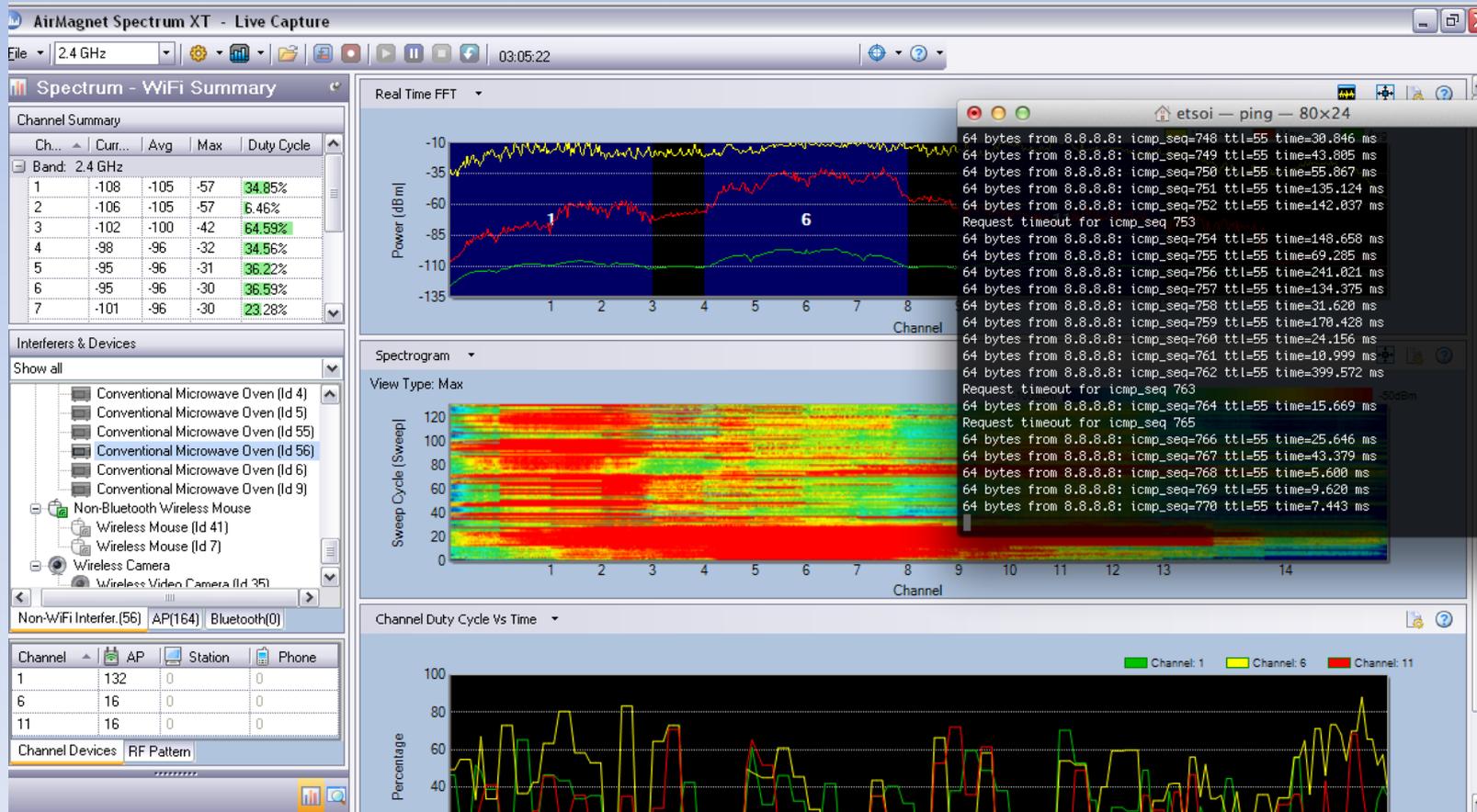
```
Approximate round trip times in milli-seconds:
```

```
    Minimum = 401ms, Maximum = 412ms, Average = 406ms
```

```
C:\>
```



# Some tools for troubleshooting (VI)





# Tips for using Wi-Fi in HKIEd (I)

- Do not predicate time sensitive activities on use of Wi-Fi
- Turn off unnecessary clients
- Encourage the use of 802.11n (5 GHz) clients
- Encourage to update wireless drivers or OS patches
- Encourage to use ssid “HKIEd” and “Hostel” for better security protection



# Tips for using Wi-Fi in HKIEd (II)

- Be considerate! Not to set up Rogue AP or tethering in campus or hostel area



# Future? (I)

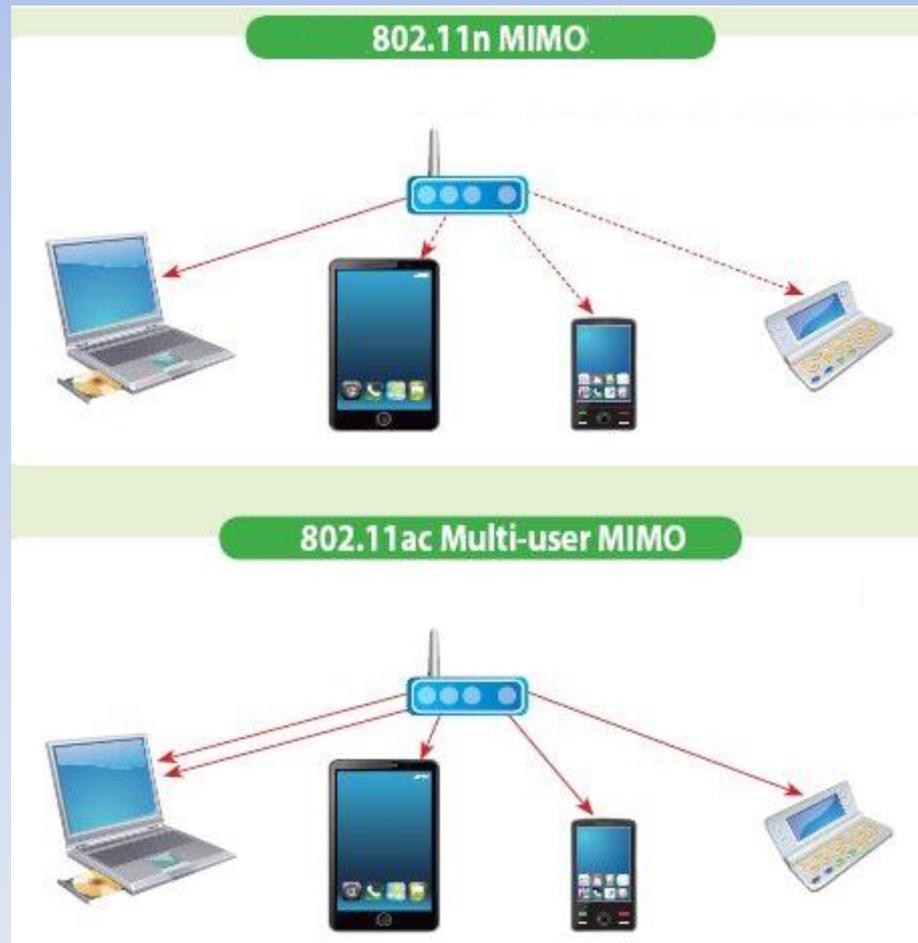
802.11ac?



- Fifth generation Wi-Fi
- Uses 5Ghz frequency band only
- 3x times faster
- Better video and online gaming experience
- Supports multi-user MIMO



# Future? (II)





# Q & A



# Wi-Fi still doesn't work?

- Get walk-in help at ITS helpdesk ( Office Hour )
- Contact help desk at 2948 6601 ( Office Hour )
- Email us at [helpdesk@its.ied.edu.hk](mailto:helpdesk@its.ied.edu.hk)
- <http://its.web.ied.edu.hk/network/wireless.htm>
- <http://its.web.ied.edu.hk/wifi101/>



# Thank You

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