

# Wireless Optimisation

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# Agenda

- Introduction
- Wireless in general
- Optimisation
- Demo (requires audience participation)
- Q & A

# INTRODUCTION

# Where is Telkom University?



- Located in Bandung, Indonesia
- 7 Faculties, 27 schools
- Areas: Engineering, Communications, Computing, Business and management, Arts
- 650+ Academic staff, 400+ Administration staff, 20000+ students
- An exchange program
- Runs mikrotik academy program

# Mikrotik academy @ TEL-U

- Started in 2013
- Embedded into schools curricula
- 100% hands-on
- Get MTCNA certification



# Speaker Introduction



- Name: Achmad Mardiansyah
- Base: Bandung, Indonesia
- Linux user since '99
- Mikrotik Certified Trainer (MTCNA/RE/WE/INE/UME/TCE) ->  
[www.glcnetworks.com](http://www.glcnetworks.com)
- Mikrotik Certified Consultant
- Mikrotik Academy coordinator
- Experiences: Telco engineer, Sysadmin, PHP programmer, project manager and Lecturer
- <http://au.linkedin.com/in/achmadmardiansyah>

# WIRELESS IN GENERAL

# What is wifi?

- International standard for wireless communication
- Defined by IEEE, number 802.11x
- Wifi operation mode:
  - Infrastructure mode. Requires access point (AP)
  - Ad hoc mode. Clients are connected without AP

Wifi layers:

Data Link Layer (MAC)	802.2			
	802.11			
Physical Layer (PHY)	<table border="1"> <tr> <td>DSSS</td> <td>FHSS</td> <td>Infrared</td> </tr> </table>	DSSS	FHSS	Infrared
DSSS	FHSS	Infrared		



# Wifi standard & data rate?

standard	release	Max rate	2.4 GHz	5 GHz	remark
802.11a	1999	54 mbps	--	yes	
802.11b	1999	11 mbps	yes	--	
802.11g	2003	54 mbps	yes	--	Improvement of 802.11b, backward compatibility
802.11n	2010	300 mbps	yes	yes	Support MIMO, requires gigabit cable (e.g. cat6)
802.11ac	2014	400 mbps	--	yes	

# Infrastructure mode

- Each station (STA) connect to AP
- An AP provide a coverage area named **BSS** (Basic Service Set)
- BSS is identified by BSSID/SSID, consist of 12HEX, usually taken from AP's MAC address
- BSS is known as cell

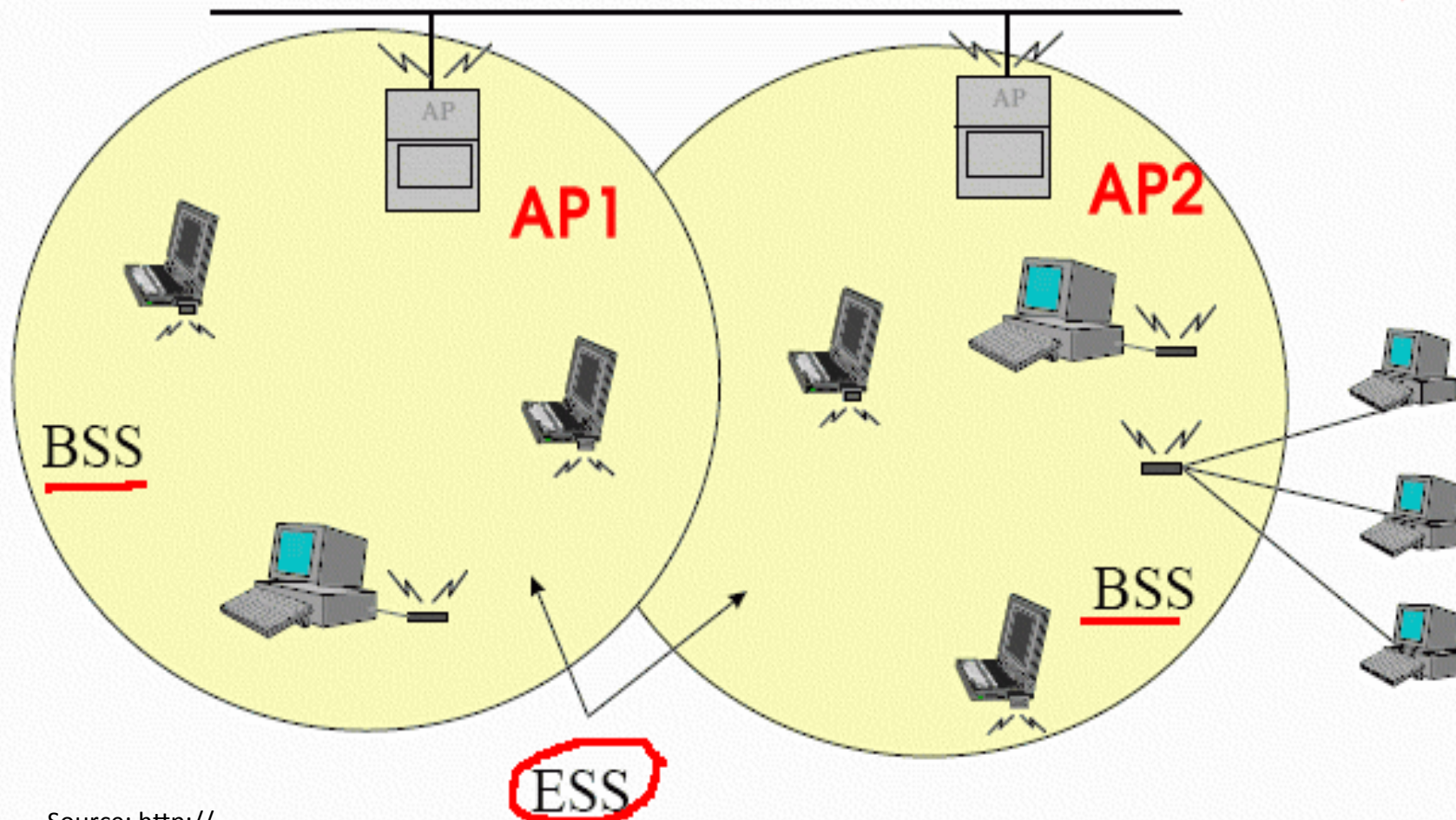


# Can we extend the coverage?

Yes. Its called the **ESS** (extended service set).

- Use cable as backbone
- ESS is identified by ESSID/SSID
- User can do **roaming** from one BSS to other BSS, based on signal strength
- This is known as distributed system (DS)

## Distribution System (= backbone network)



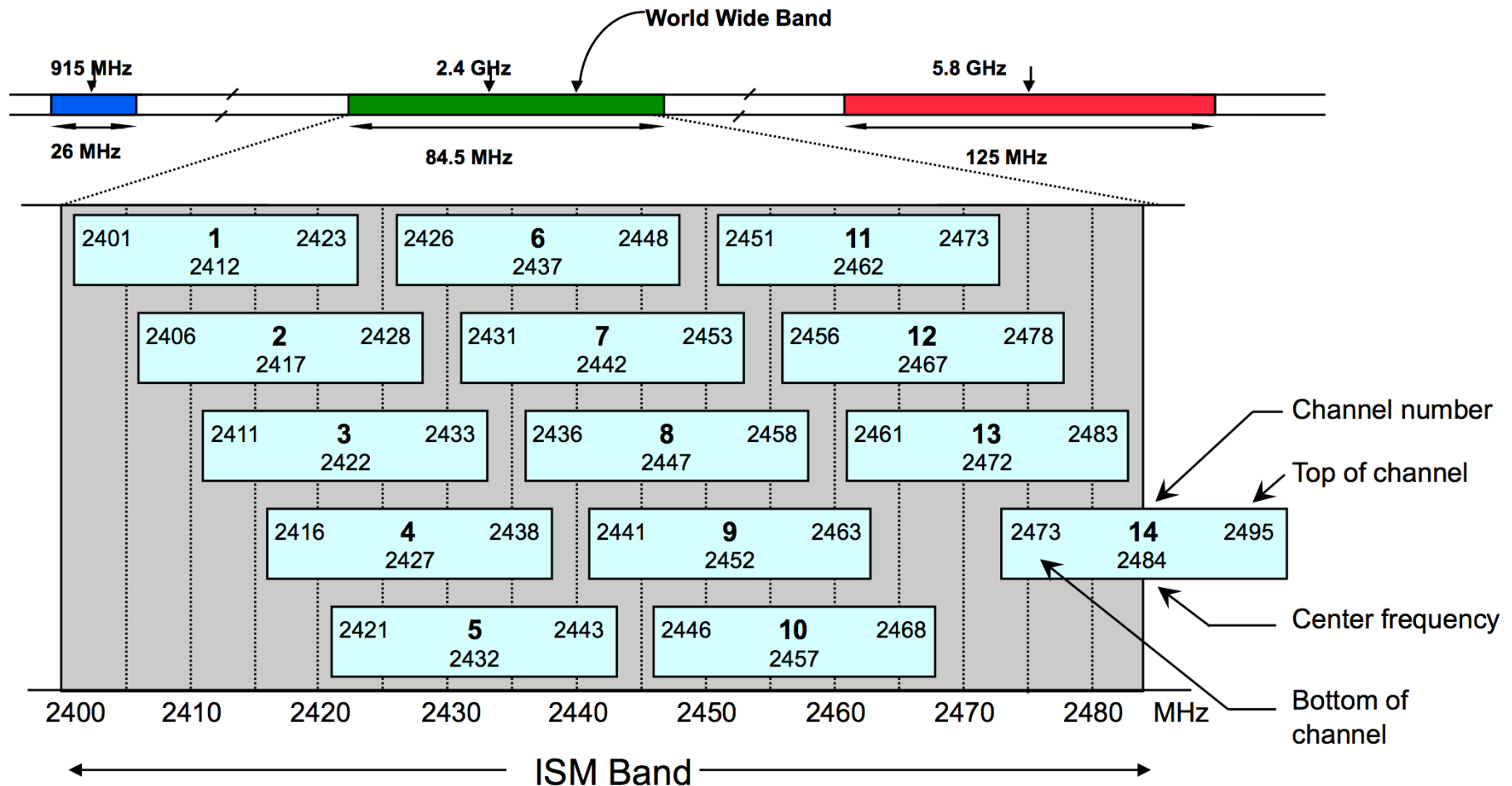
Source: <http://www.mathcs.emory.edu/~cheung/Courses/455/Syllabus/3a-MAC/FIGS/wireless-topology.gif>

# Is it possible if the backbone is wireless?

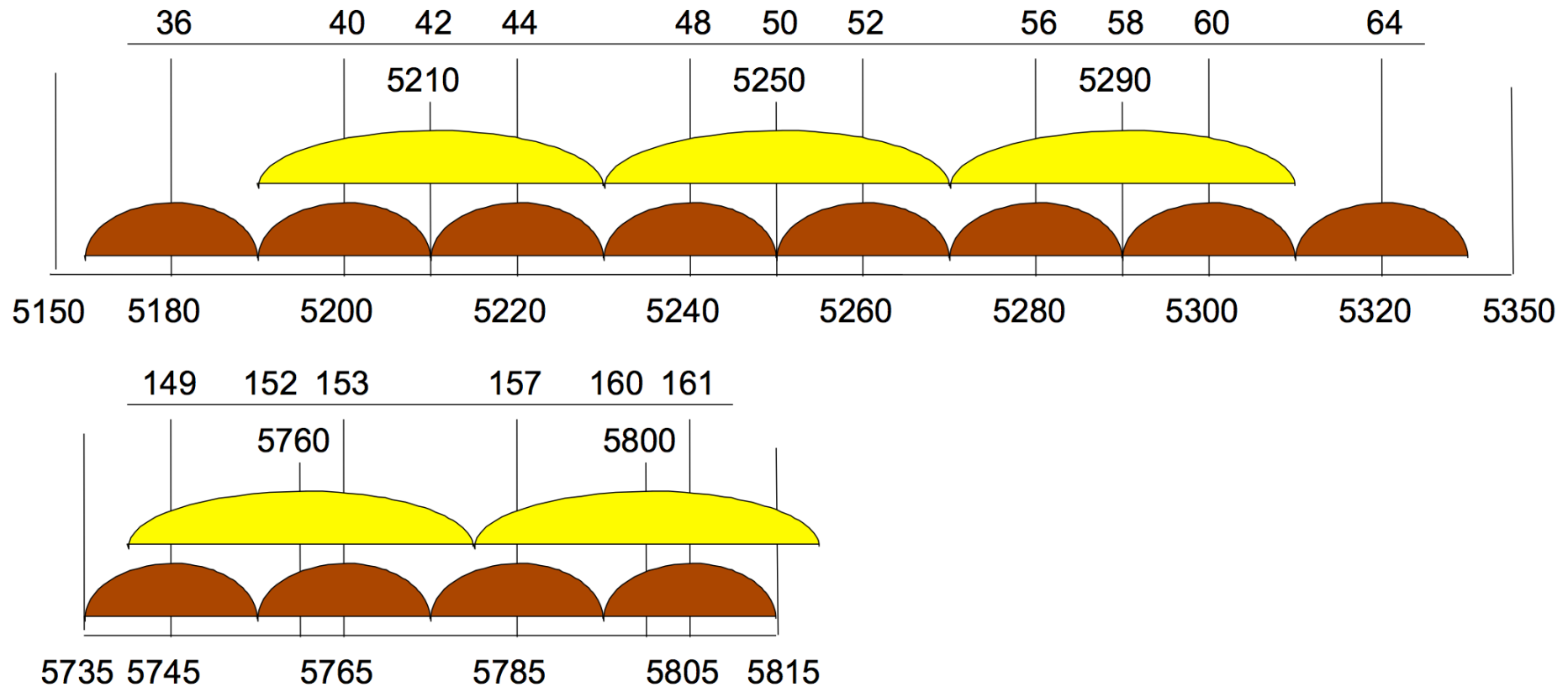
Yes. It is called wireless distributed system (WDS)



# 802.11 (2.4GHz) channel?

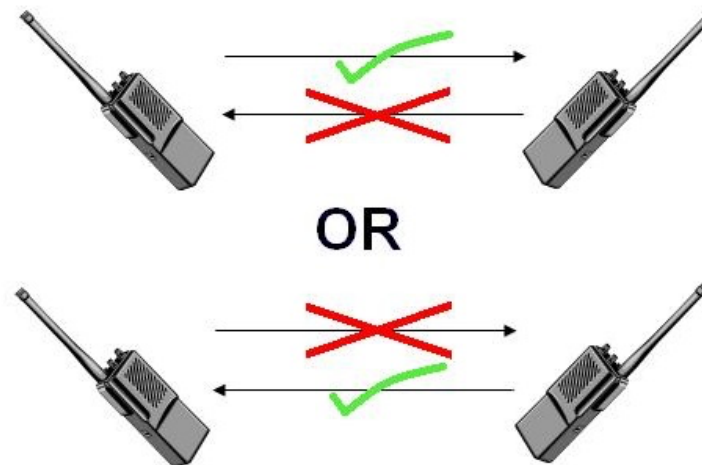


# 802.11 (5GHz) channel?



# Is 802.11 full-duplex or half-duplex?

- 1 channel for all user
- When 1 station is sending, others must wait
- No timeslot allocated for each station
- CSMA/CA





# CSMA/CA

- Carrier Sense Multiple Access / Collision Avoidance
- **Every station on the network should be able to listen each other**
- If not -> hidden node problem



# Wireless terminologies?

In wireless, we use term:

- Station/CPE (Customer Premise Equipment) is the device that connects to AP
- Access Point (AP) as the main controller

In wired networking: client / server

# Wireless topology?

- PTP (point to point), single antenna
  - Usually for long distance
- PTP, dual antenna (dual antenna)
  - long distance, backhaul
  - Can use mikrotik dual nstream protocol. 1 tx, 1 rx (full duplex)
- PTMP (point to multi point)
  - Usually for end-user. Eg. Café, campus, offices
- WDS (wireless distributed System)

# OPTIMISATION

# What is optimisation?

## optimization

Also found in: [Medical](#), [Legal](#), [Financial](#), [Acronyms](#), [Encyclopedia](#), [Wikipedia](#).


## op·ti·mize (öp'tə-mīz')

*tr. v.* op·ti·mized, op·ti·miz·ing, op·ti·miz·es

1. To make as perfect or effective as possible.
2. *Computers* To increase the computing speed and efficiency of (a program), as by rewriting instructions.
3. To make the most of.

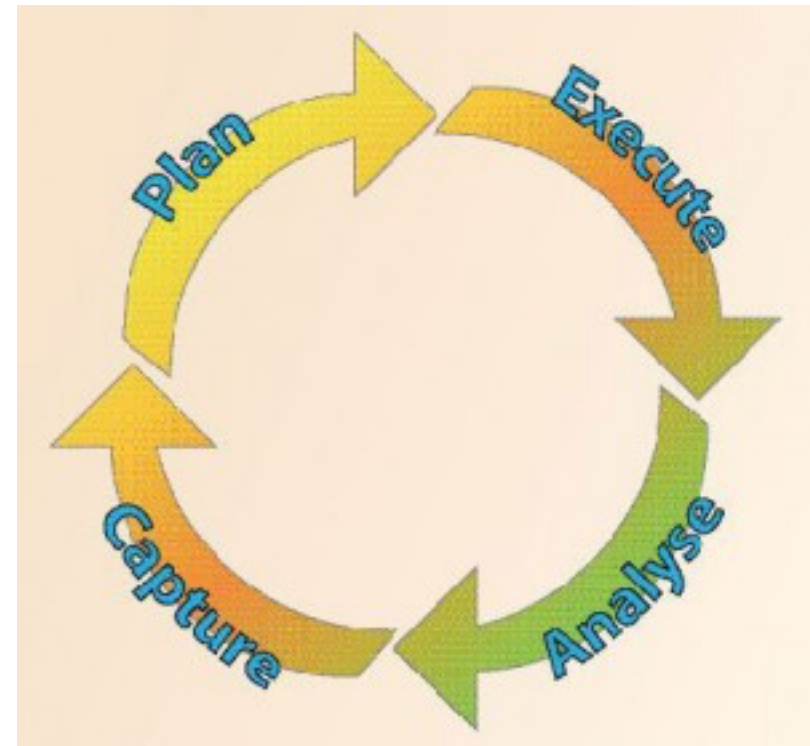
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**op'ti-mi-za'tion** (-mī-zā'shən) *n.*

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# What to expect from optimisation?

- Stable connection
- Can achieve the limit of technology
- Note:
  - Wireless is dynamic
  - It is a continuous process





# DEMO

# CPE optim

- GOAL: Make sure a CPE can establish a connection to AP
- Tools
  - Scanner
  - Alignment (audio beeper)
  - Quickset



# CPE tool: scanner

Scanner (Running) □ ×

Interface:  ▾

Start

Stop

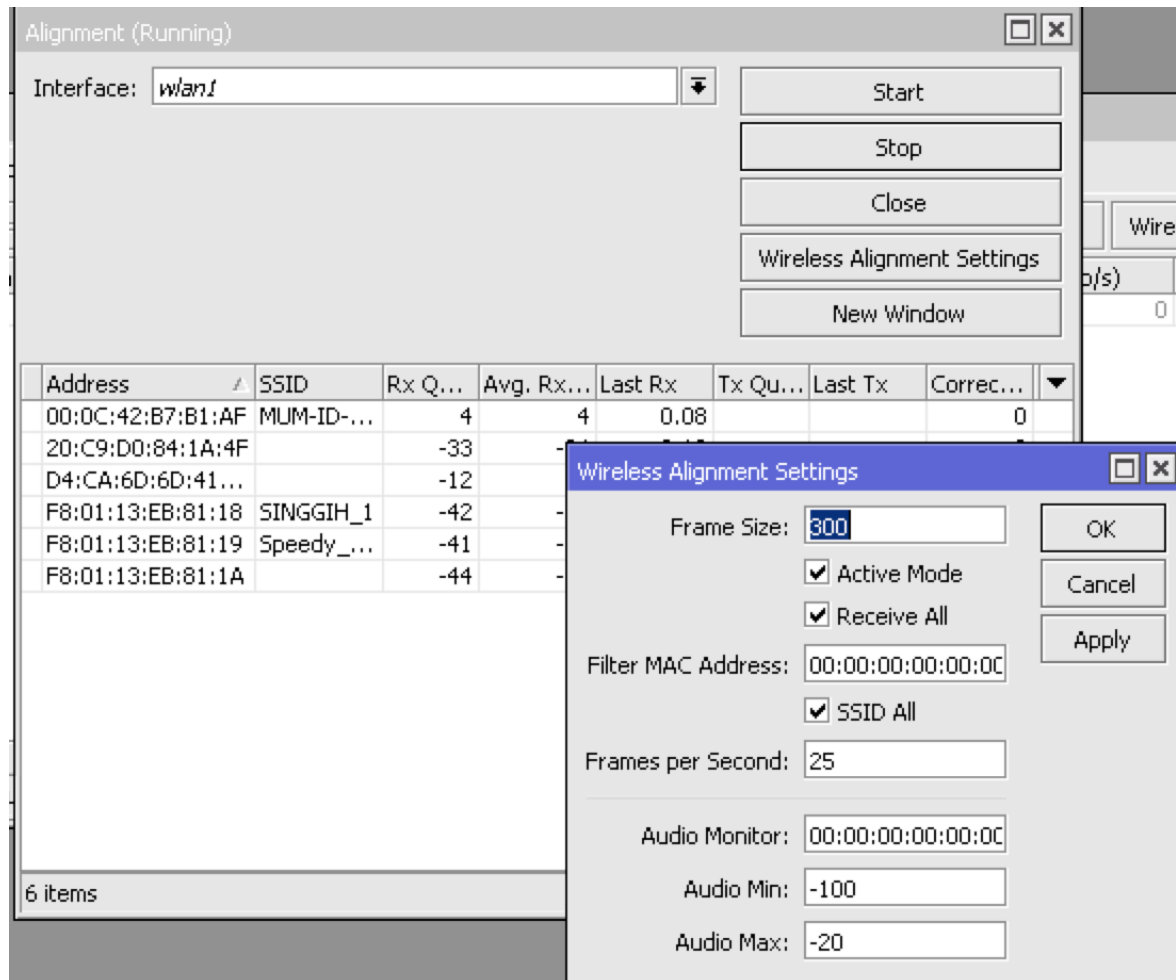
Close

Connect

New Window

	Address	SSID	Channel	Sign...	Nois...	Sign...	Radio Name	Router...	▼
AP	A0:88:B4:93:8C:79	ARTOM...	2427/...	-82	-102	20			
ARB	00:0C:42:B7:B1:AF	MUM-ID-...	2437/...	4	-103	107	99_TEACHER	6.32.2	
AP	F8:01:13:EB:81:18	SINGGIH_1	2437/...	-43	-103	60			
A	F8:01:13:EB:81:19	Speedy_...	2437/...	-43	-103	60			
AP	F8:01:13:EB:81:1A		2437/...	-46	-103	57			
AP	08:63:61:EF:F1:C8	Doni@wifi	2462/...	-84	-105	21			
A	08:63:61:EF:F1:C9	@wifi.id	2462/...	-85	-105	20			
AP	08:63:61:EF:F1:CA		2462/...	-85	-105	20			

# CPE tool: Alignment (beeper)



The screenshot shows the 'Alignment (Running)' application window. The 'Interface' is set to 'wan1'. Below the interface selection is a table of wireless network data. A 'Wireless Alignment Settings' dialog box is open in the foreground, showing various configuration options.

Address	SSID	Rx Q...	Avg. Rx...	Last Rx	Tx Qu...	Last Tx	Correc...
00:0C:42:B7:B1:AF	MUM-ID-...	4	4	0.08			0
20:C9:D0:84:1A:4F		-33					
D4:CA:6D:6D:41...		-12					
F8:01:13:EB:81:18	SINGGIH_1	-42					
F8:01:13:EB:81:19	Speedy_...	-41					
F8:01:13:EB:81:1A		-44					

The 'Wireless Alignment Settings' dialog box contains the following fields and options:

- Frame Size: 300
- Active Mode
- Receive All
- Filter MAC Address: 00:00:00:00:00:00
- SSID All
- Frames per Second: 25
- Audio Monitor: 00:00:00:00:00:00
- Audio Min: -100
- Audio Max: -20

# CPE tool: quickset

CPE Quick Set

**- Info**

WLAN MAC Address:

LAN MAC Address:

**- Wireless**

Country:

Channel Width:

	Address	Network ...	Channel
RB	00:0C:42:B7:B1:AF	MUM-ID-...	2437/20/gn
P	08:63:61:EF:F1:C8	Doni@wifi	2462/20/gn
	08:63:61:EF:F1:C9	@wifi.id	2462/20/gn
P	08:63:61:EF:F1:CA		2462/20/gn
P	A0:88:B4:93:8C:79	ARTOM...	2412/20/gn
P	F8:01:13:EB:81:18	SINGGIH_1	2437/20/gn
	F8:01:13:EB:81:19	Speedy_...	2437/20/gn
P	F8:01:13:EB:81:1A		2437/20/gn

**- Configuration**

Mode:  Router  Bridge

**- Bridge**

Address Acquisition:  Static  Automatic

IP Address:

Netmask:

Gateway:

DNS Servers:

**- System**

Router Identity:

Signal Strength:

Network Name:

# AP optim

- GOAL: Make sure AP provides optimal service to CPE
- Tools:
  - Frequency usage
  - Snooper
  - Spectrum analyzer (thedude)

# How to make mikrotik as an access point? (easy way)

Home AP Quick Set

**Wireless**

Network Name: MUM-ID-2015-TEL-U-2GHz

Frequency: 2437 MHz

Band: 2GHz-B/G/N

Country: no\_country\_set

MAC Address: D4:CA:6D:4C:98:15

Use Access List (ACL)

WiFi Password:

WPS Accept

**Guest Wireless Network**

Guest Network:

**Wireless Clients**

MAC Address	In ACL	Last IP	Uptime	S
-------------	--------	---------	--------	---

**Internet**

Address Acquisition:  Static  Automatic  PPPoE

IP Address: 192.168.99.100 Renew Release

Netmask: 255.255.255.0 (/24)

Gateway: 192.168.99.1

MAC Address: D4:CA:6D:4C:98:10

Firewall Router

**Local Network**

IP Address: 0.0.0.0

Netmask: 255.0.0.0 (/8)

DHCP Server

NAT

UPnP

**VPN**

VPN Access

VPN Address: 3a650267afef.sn.mynetname.net

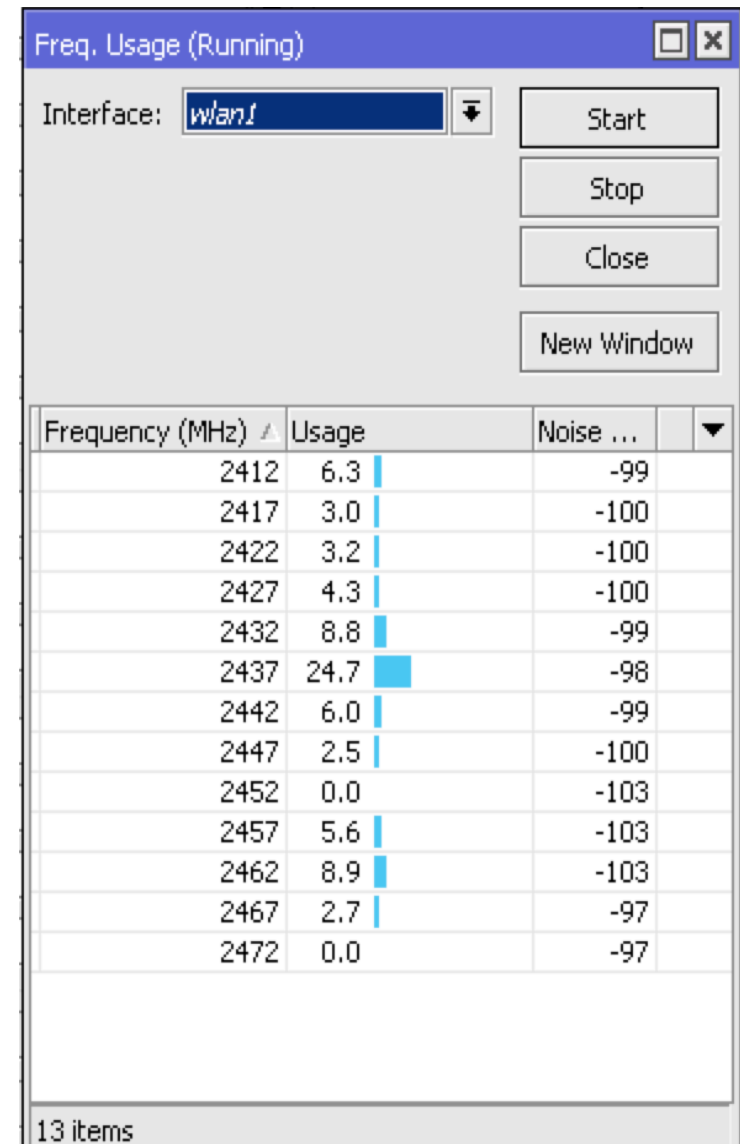
**System**

Check For Updates Reset Configuration

Password...

# AP tool: frequency usage

- To find less crowded frequency
- Get information about noise floor



# AP tool: snooper

- Display load and traffic on each frequency

Wireless Snooper (Running)

Interface: wlan1

Start  
Stop  
Close  
Settings  
New Window

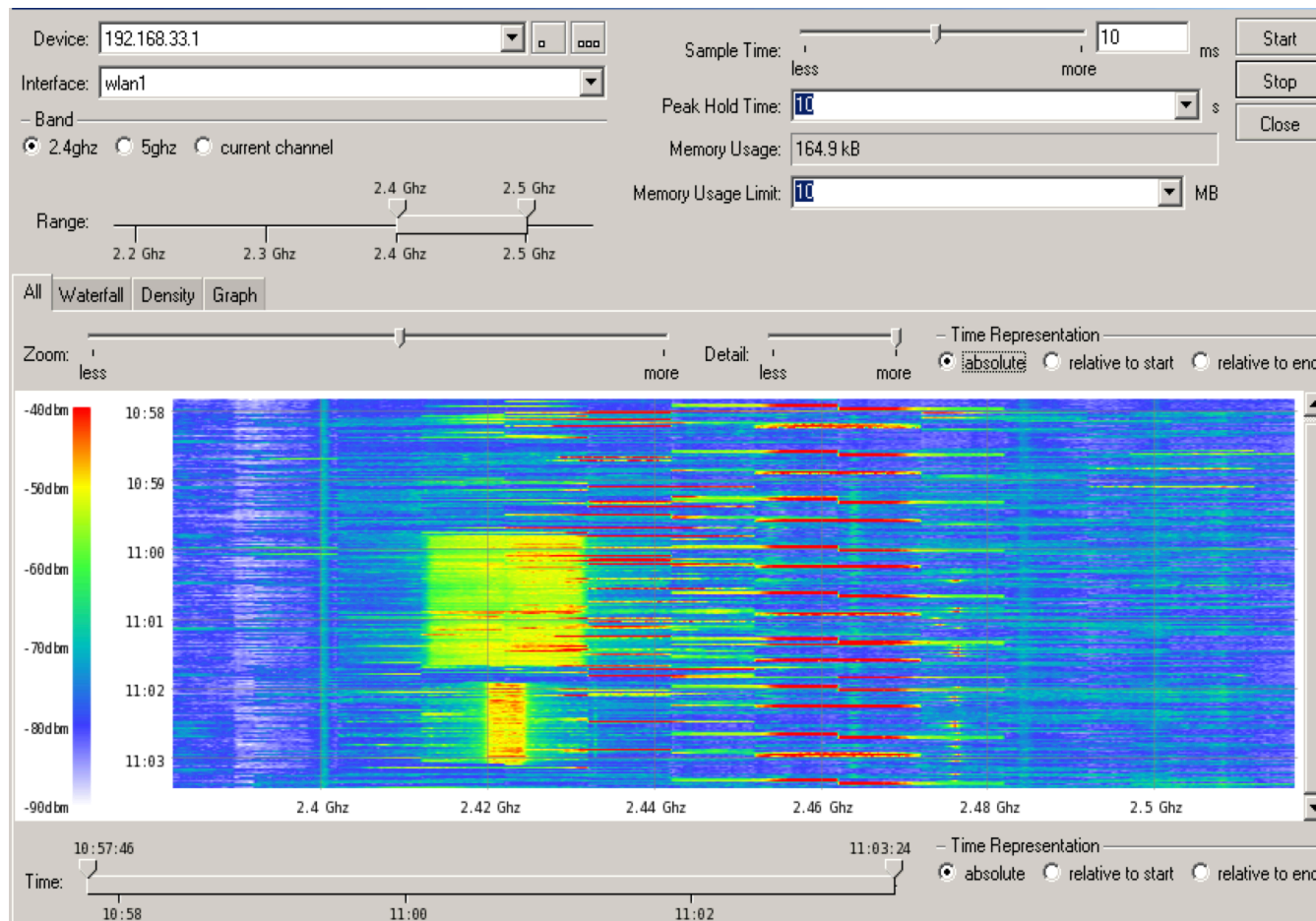
all

Frequen...	Band	Address	SSID	Signal	Of Freq. (%)	Of Traf. (%)	Bandwidth	Net...	Sta...
2412	2GHz-N				87.2		855.4 kbps	1	1
2412	2GHz-N	24:E2:71:9B:FF:78	Smartfren...		87.2	100.0	855.4 kbps		1
...		24:E2:71:9B:FF:78	Smartfren...	-64	66.8	91.8	655.4 kbps		
2417		00:12:5F:07:B9:CC		-93	1.2	1.6	11.2 kbps		
2417	2GHz-N				96.7		891.1 kbps	0	0
2422	2GHz-N				17.8		175.0 kbps	0	0
2427	2GHz-N				24.4		125.6 kbps	0	0
2432	2GHz-N				5.0		36.1 kbps	1	1
2432	2GHz-N	00:12:5F:07:B9:CA	Meeting-04		1.2	24.8	11.5 kbps		1
...		00:12:5F:07:B9:CA	Meeting-04	-85	1.2	24.8	11.5 kbps		
2437		00:18:C2:00:2F:77		-79	0.0	0.0	0 bps		
2437		00:18:C2:00:3D:8B		-90	0.0	0.0	0 bps		
2437	2GHz-N				11.6		87.5 kbps	6	8
2437	2GHz-N	00:18:C2:00:2F:51	Keraton a...		1.0	8.6	9.0 kbps		1
...		00:18:C2:00:2F:51	Keraton a...	-91	1.0	8.6	9.0 kbps		
2437	2GHz-N	88:1F:A1:33:5C:D8			1.0	9.3	9.9 kbps		1

50 items

# AP tool: spectrum analyzer

- Display interference with wider range
- Currently only available for atheros merlin chipset





# Suggestion to Mikrotik

- When we run previous wireless tools, connection will be off because wireless interface
- Suggestion: Put additional chipset that is used to perform optimisation tool

# AP tool: registration table

- Display signal strength for each client

Interfaces	Nstreme Dual	Access List	Registration	Connect List	Security Profiles	Channels				
Radio Name	MAC Address	Interface	Uptime	AP	...	Last Activi...	Tx/Rx Signal ...	Tx/Rx Rate		
99_TEACHER_wlan1	00:0C:42:B7:B1:AF	wlan1	02:27:44	yes	no	5.010	-24/-21	54.0Mbps...		

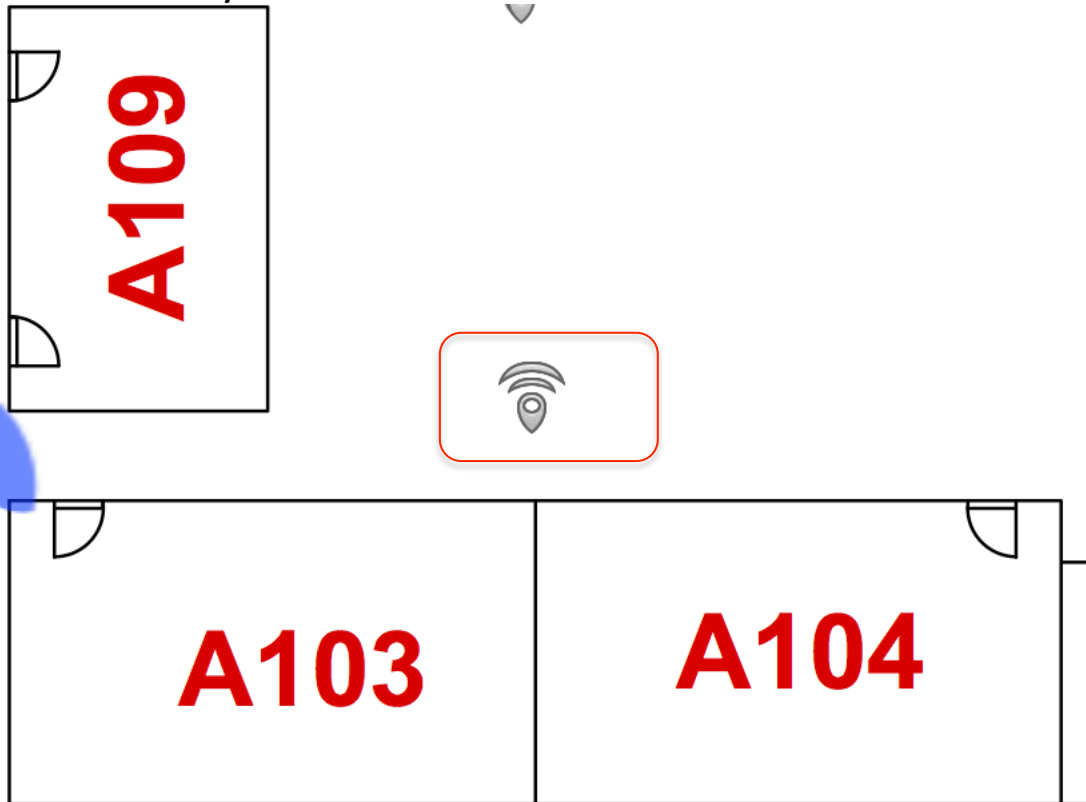
# AP tool: Wireless survey

- GOAL: get a perfect location for AP
- The **ultimate weapon** for wireless troubleshooting
- Pick several samples points and analyse the performance
- Case study: troubleshooting of bad wireless access

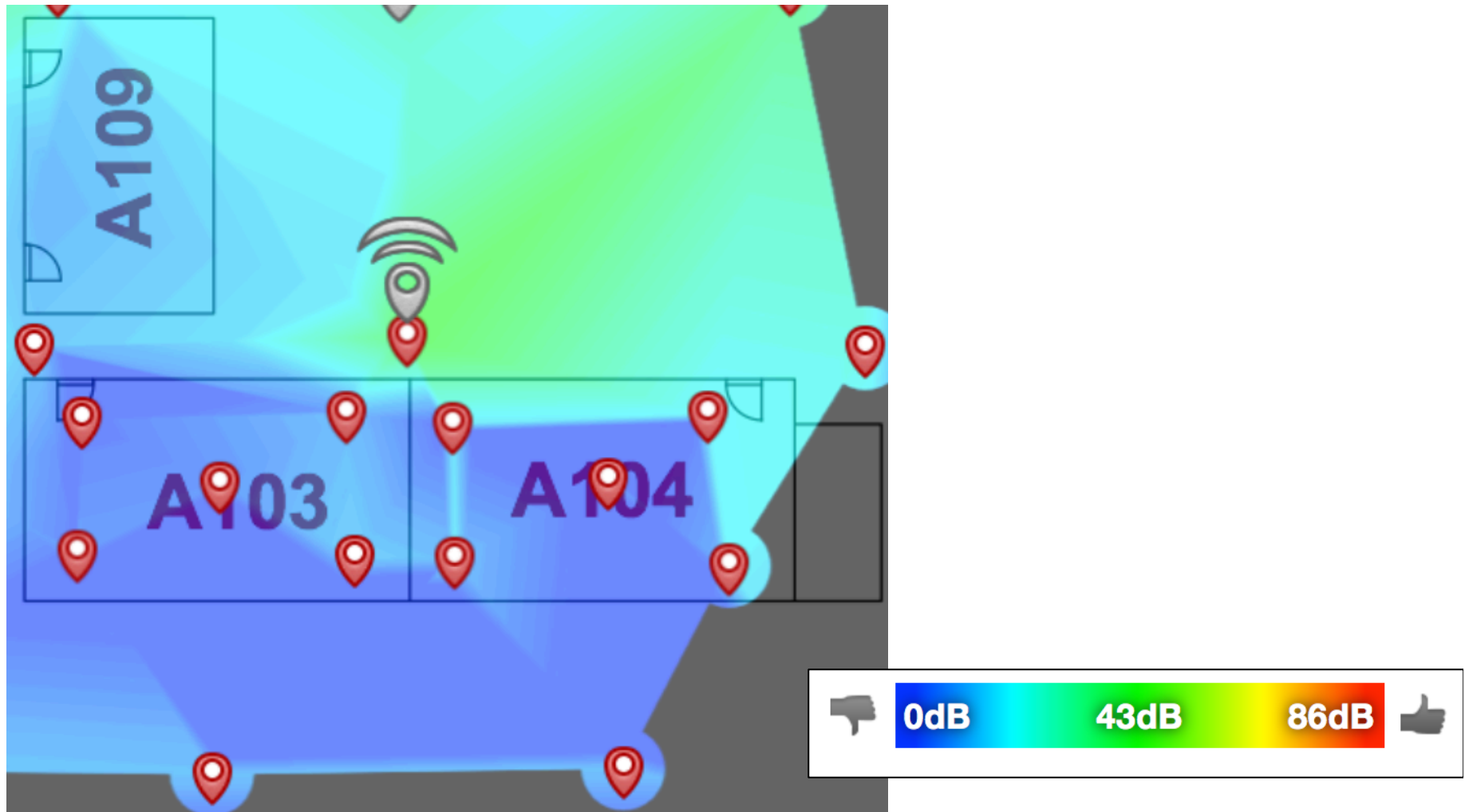
# Case study: AP location

- AP is located outside the rooms
- To cover 2 rooms (A103 & A104)
- Is this enough?

Lets survey....



# Signal to noise ratio (SNR)



# Download test...



# The Myths

- Wireless is difficult, cannot be seen -> use wireless tool, to visualise the spectrum
- Brand determines the performance -> The location is more important
- Wireless is complex -> get a correct understanding of how wireless works
- Add more bandwidth solves everything -> depends on location
- We do not need wire -> wire is still needed as its more reliable and has more physical bandwidth

# Still curious about wireless?

Just come to our training course!!! 😊





# Q & A

# End of presentation

- Thank you
- Please put your feedback
- Stay tune with our schedule