MikroTik for K-12 Schools in Lebanon Wi-Fi, CAPsMAN, Web Proxy

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Beirut - Lebanon

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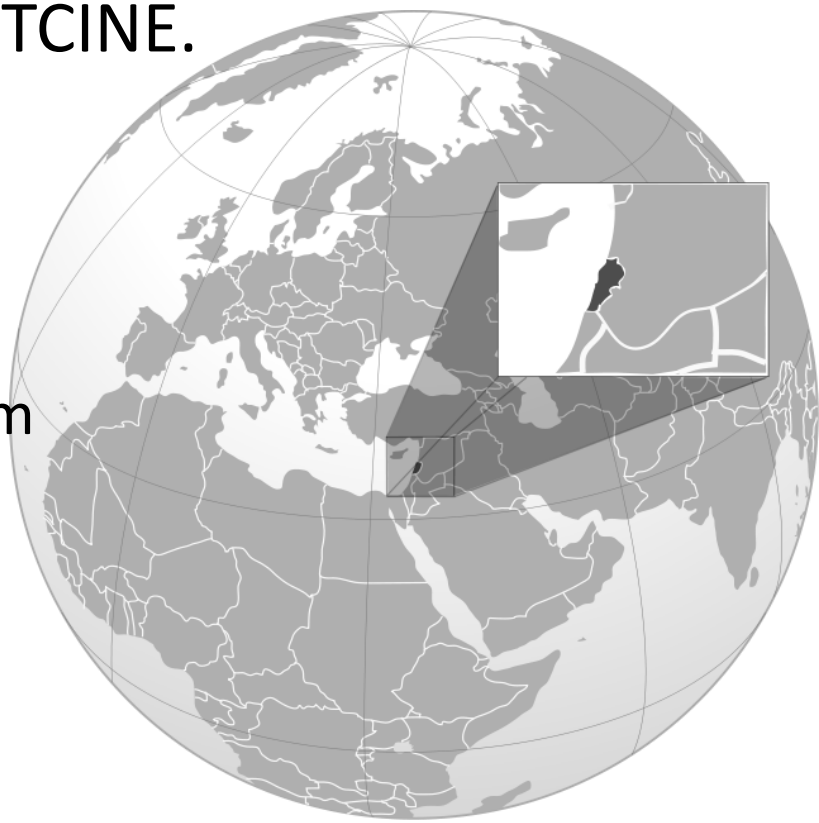
http://ConnectionGT.com

About me, the MikroTik Certified Trainer

- Name: Khalil Chamseddine
- Experience: Software, Hardware and Networking
- Places: Lebanon, Canada, Afghanistan…
- MikroTik Trainer in Lebanon and Region: MTCNA, MTCWE, MTCTCE, MTCUME, MTCRE and MTCINE.



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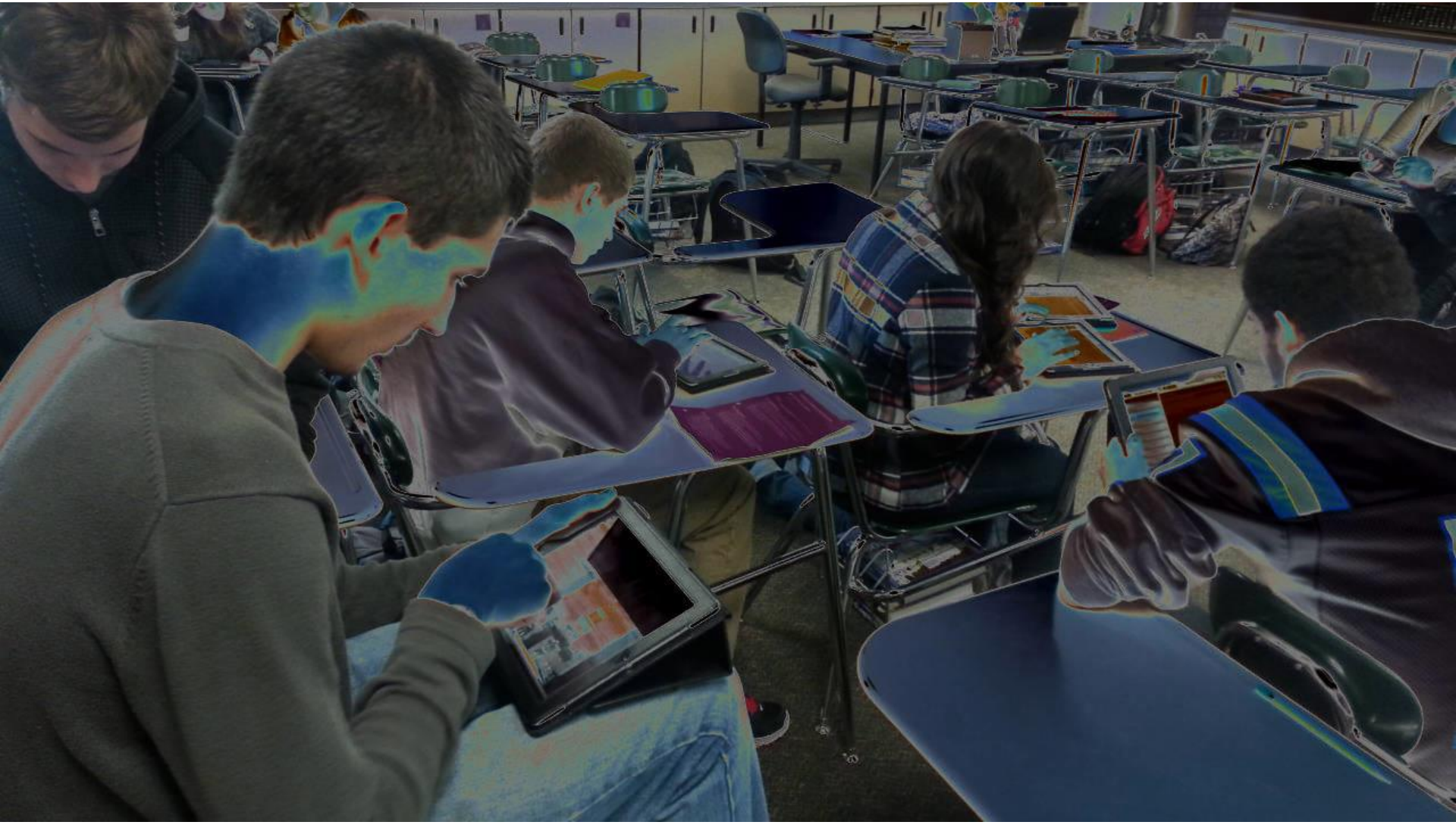
Outline

- School Requirements
- Design Considerations
- CAPsMAN
- CAPs: RouterBOARDs
- Web Proxy

School Requirements

- Provide Wireless Internet to Students in their classrooms



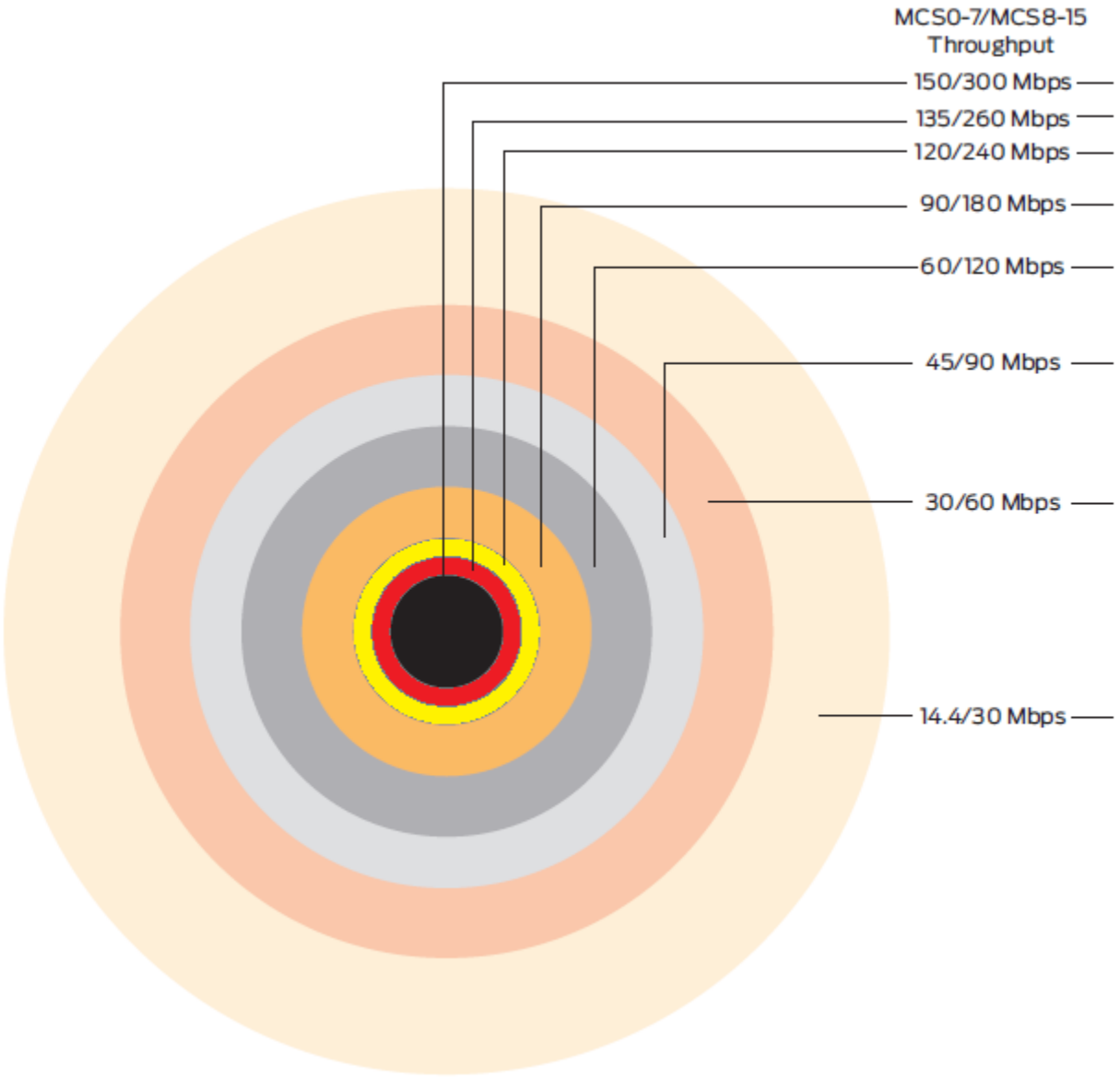
School Requirements

- Provide Wireless Internet to Students in their classes
  - Typical, 2~3Mbps per student
- Devices used: Laptops, Tablets, iPads
  - Educational Sites, Email, Some YouTube…
- Frequency Bands: Currently: 2.4GHz, Future, maybe 5Ghz
- Have the option to filter some internet traffic and some caching
- **Solution should be easy to manage**
- Our Typical School has “L” shape Building
  - 5 floors, 50 class rooms, 20~30 devices per class

Design Considerations

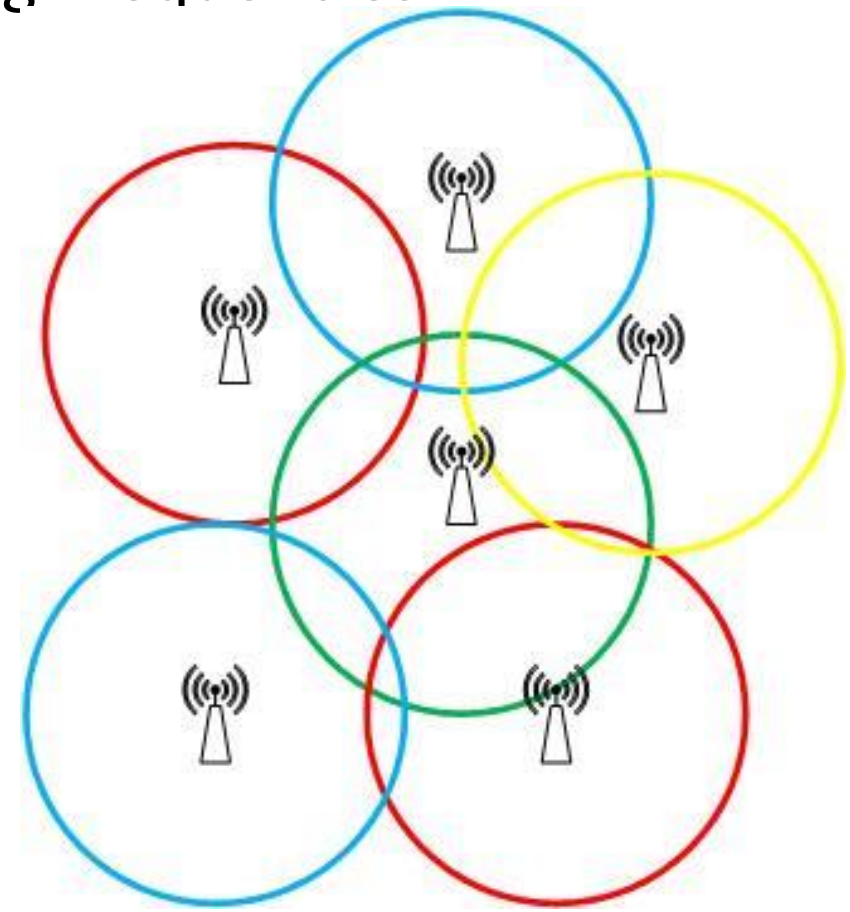
- Capacity versus Coverage
- Coverage Overlapping
- Frequency Overlapping
- Simple, centralized management

Capacity versus Coverage



Overlapping

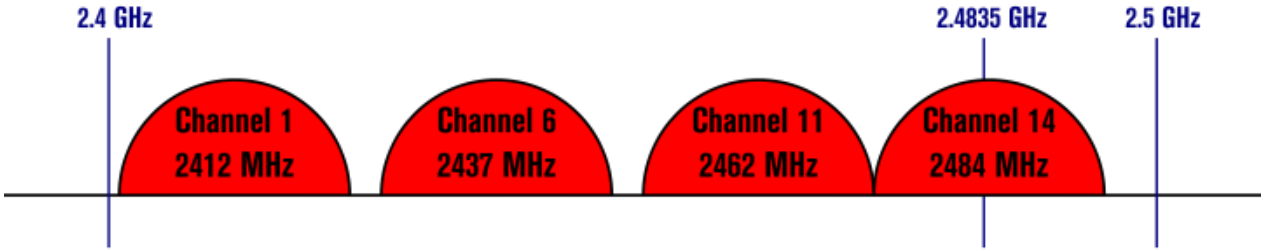
- Overlapping Coverage for good roaming
- Overlapping Channels
- Not Overlapping Frequencies



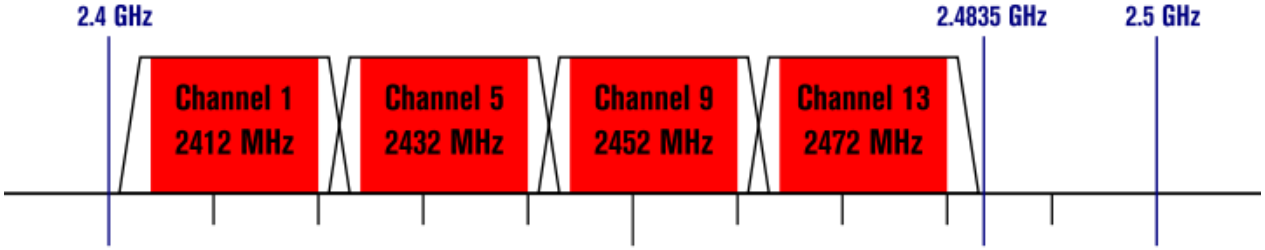
Channel Planning 2.4Ghz

Non-Overlapping Channels for 2.4 GHz WLAN

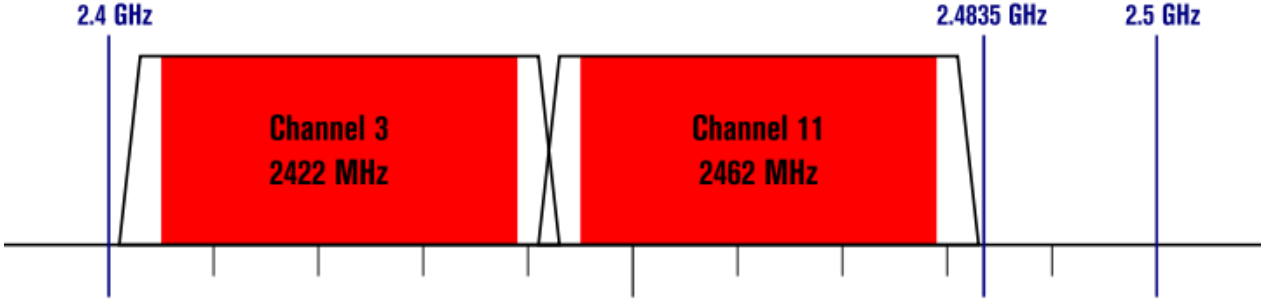
802.11b (DSSS) channel width 22 MHz



802.11g/n (OFDM) 20 MHz ch. width – 16.25 MHz used by sub-carriers



802.11n (OFDM) 40 MHz ch. width – 33.75 MHz used by sub-carriers



802.11n MCS

MCS index	Spatial streams	Modulation type	Coding rate	Data rate (Mbit/s)			
				20 MHz channel		40 MHz channel	
				800 ns GI	400 ns GI	800 ns GI	400 ns GI
0	1	BPSK	1/2	6.50	7.20	13.50	15.00
1	1	QPSK	1/2	13.00	14.40	27.00	30.00
2	1	QPSK	3/4	19.50	21.70	40.50	45.00
3	1	16-QAM	1/2	26.00	28.90	54.00	60.00
4	1	16-QAM	3/4	39.00	43.30	81.00	90.00
5	1	64-QAM	2/3	52.00	57.80	108.00	120.00
6	1	64-QAM	3/4	58.50	65.00	121.50	135.00
7	1	64-QAM	5/6	65.00	72.20	135.00	150.00
8	2	BPSK	1/2	13.00	14.40	27.00	30.00
9	2	QPSK	1/2	26.00	28.90	54.00	60.00
10	2	QPSK	3/4	39.00	43.30	81.00	90.00
11	2	16-QAM	1/2	52.00	57.80	108.00	120.00
12	2	16-QAM	3/4	78.00	86.70	162.00	180.00

MCS Details

- MCS INDEX VALUE
  - reference for “# of spatial streams + modulation + coding rate".
- SPATIAL STREAMS
  - 4 spatial streams (802.11n)
  - 8 spatial streams (802.11ac)
- MODULATION TYPE
  - The more complex the modulation, the higher the data rate.
- CODING RATE
  - how much of the data stream is actually used to transmit usable data.
- GUARD INTERVAL
  - pause between packet transmission to ignore false information
- CHANNEL WIDTH
  - This is how much of the channel is being used.

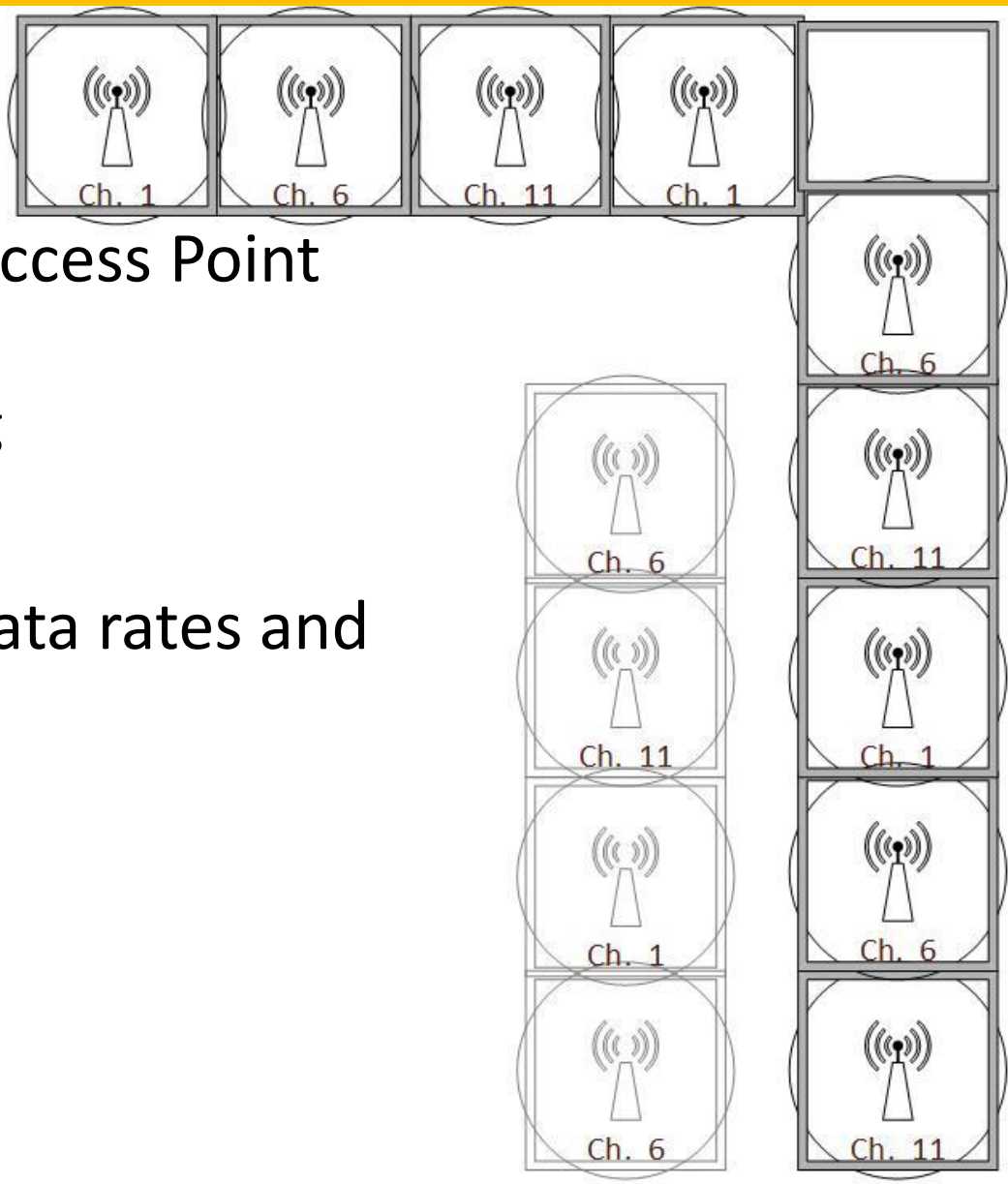
Solution Layout

- Each class shall have one Access Point
- Use only 802.11n (2.4Ghz) and some 802.11g
- Use CAPsMAN to manage the Access Points
- Tweak the TX power, the data rates

Data Rates, Channels, TX Power, AP-Tx Limit

- Use g/n for compatibility
  - 802.11n Data Rates: Select MCS-05 to MCS-14
  - 802.11g Data Rates: 24MHz, 48MHz
  - Channel Width 20MHz
  - Long Guarded Interval
- Channels: Use only Channels 1, 5, 9, and 13 or
  - Channels 1, 6, 11, if necessary
- TX Power: Start with 10dBm (for example).
  - Decrease to 7dBm if necessary
  - Increase to 17 dBm if necessary
- AP-TX Limit: Limit it to 3MB per client using the Access List.
  - Reminder: Limit rate of data transmission to this client. Value 0 means no limit. Value is in bits per second.

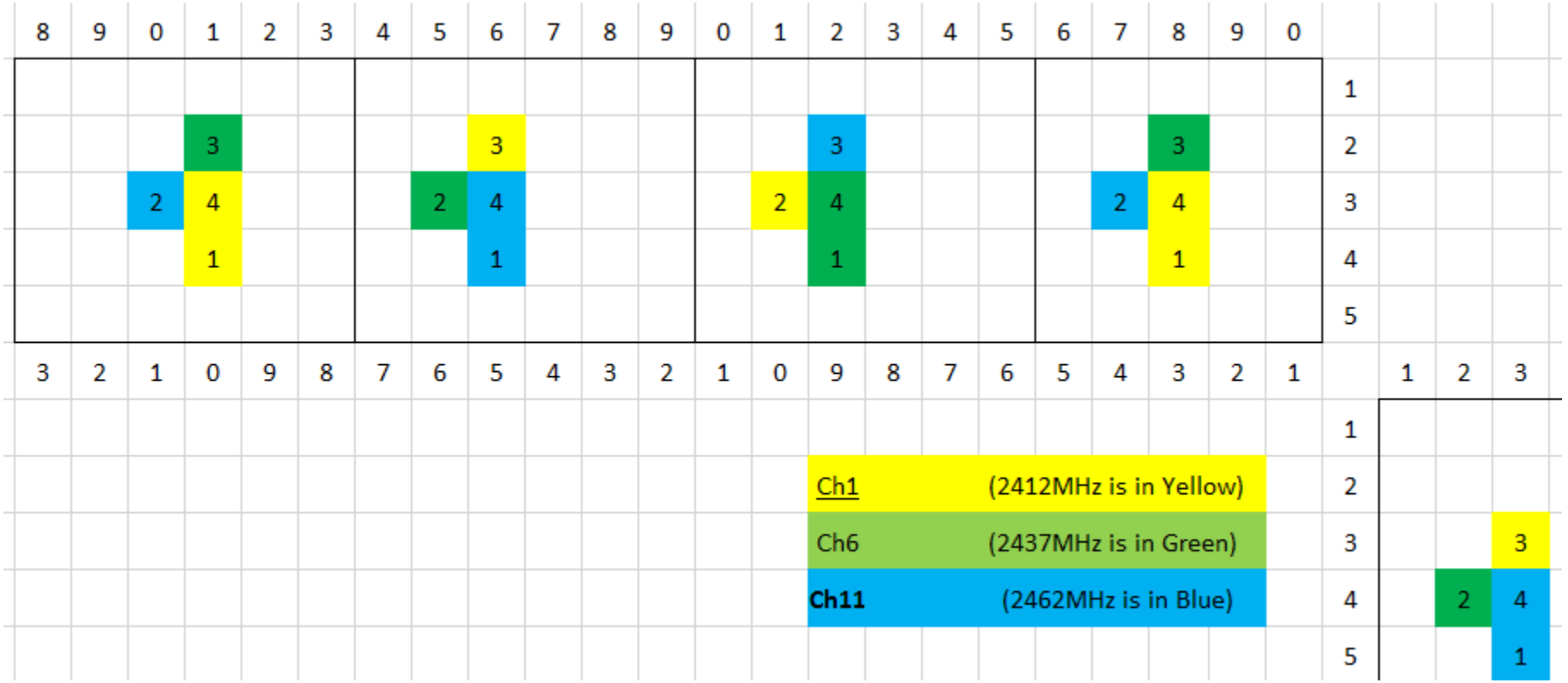
Solution Layout



- Each class shall have one Access Point
  - Capacity vs Coverage
  - Best in the middle of ceiling
- Tweak the TX power, the data rates and
  - Coverage overlapping: Yes
  - Frequency overlapping: No

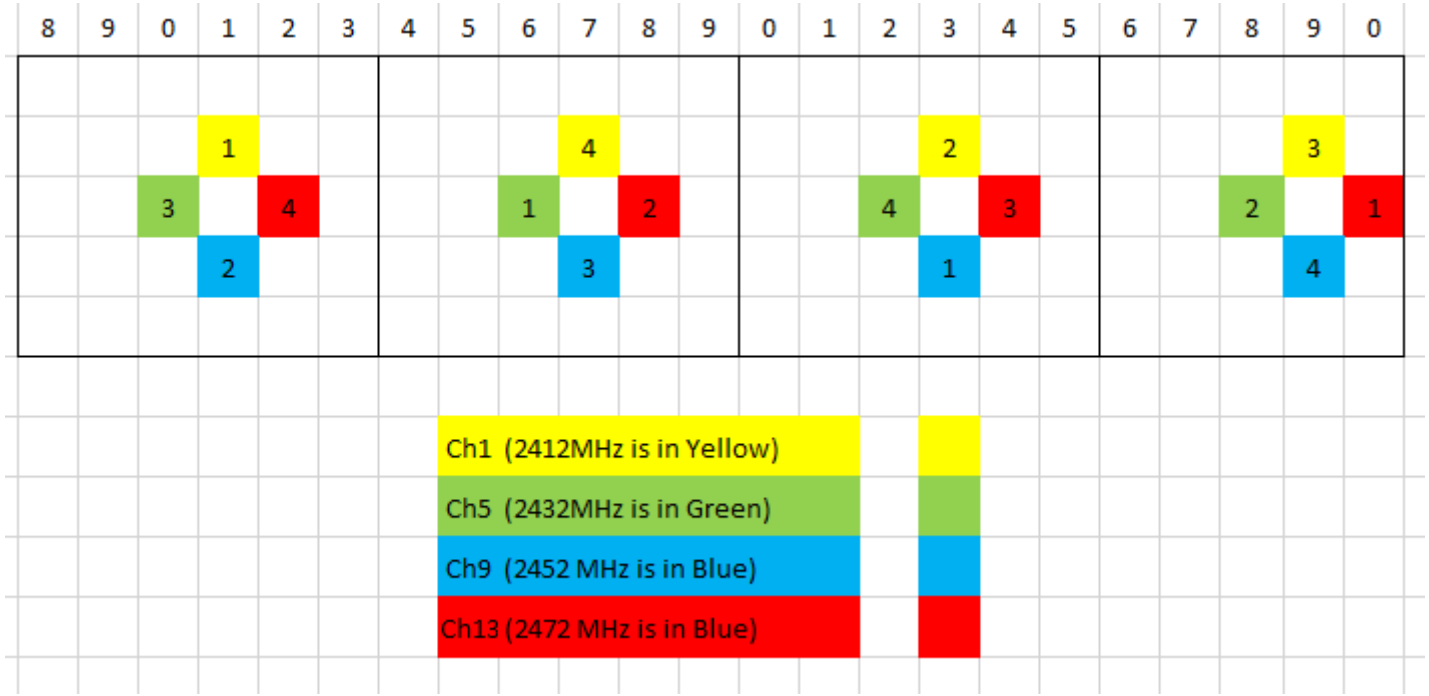
Plot channels for all floors

- Plan the coverage overlapping and frequency non-overlapping; using excel sheet for example.
- If using 3 channels: Risk of some frequency overlapping

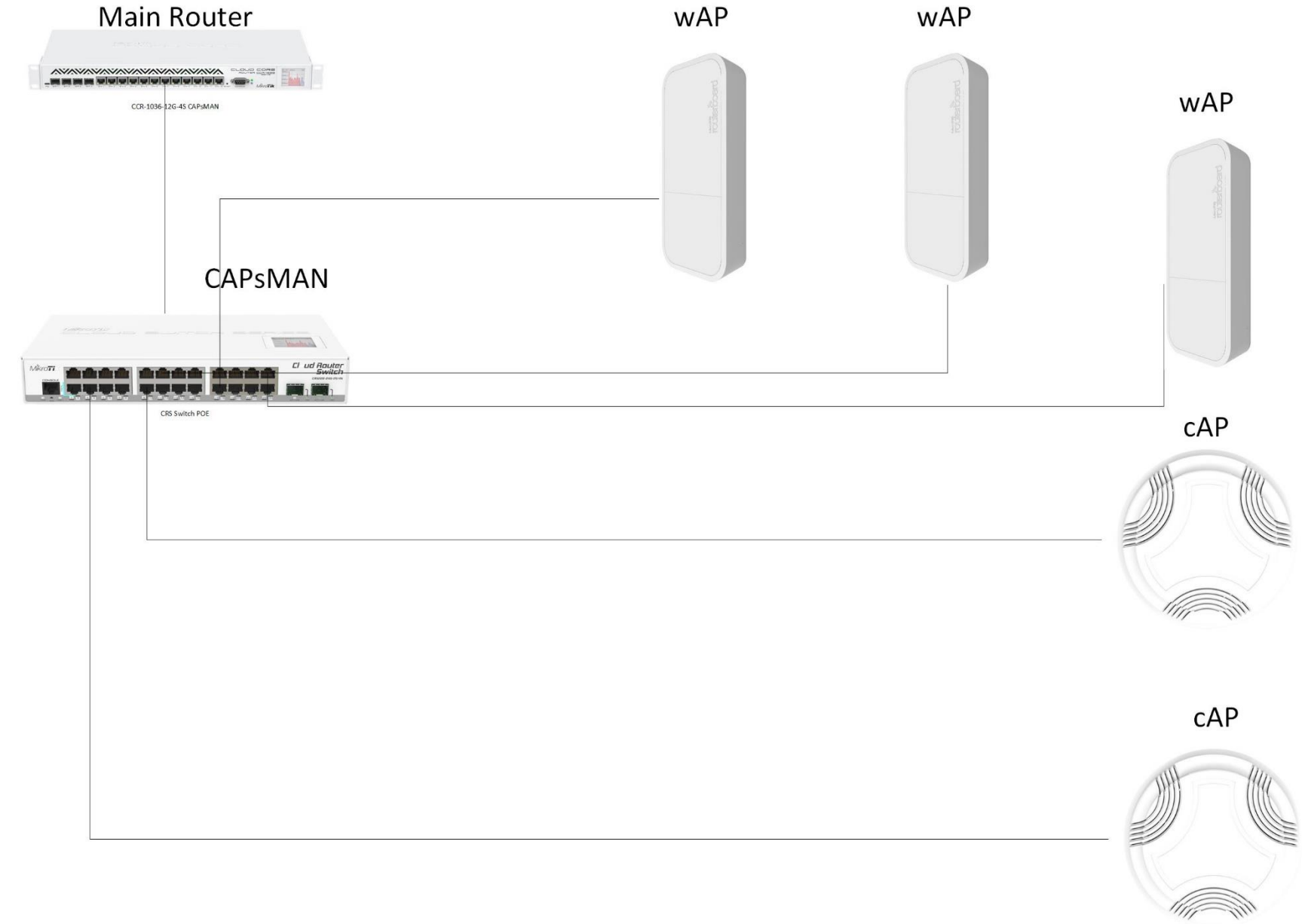


Plot channels for all floors

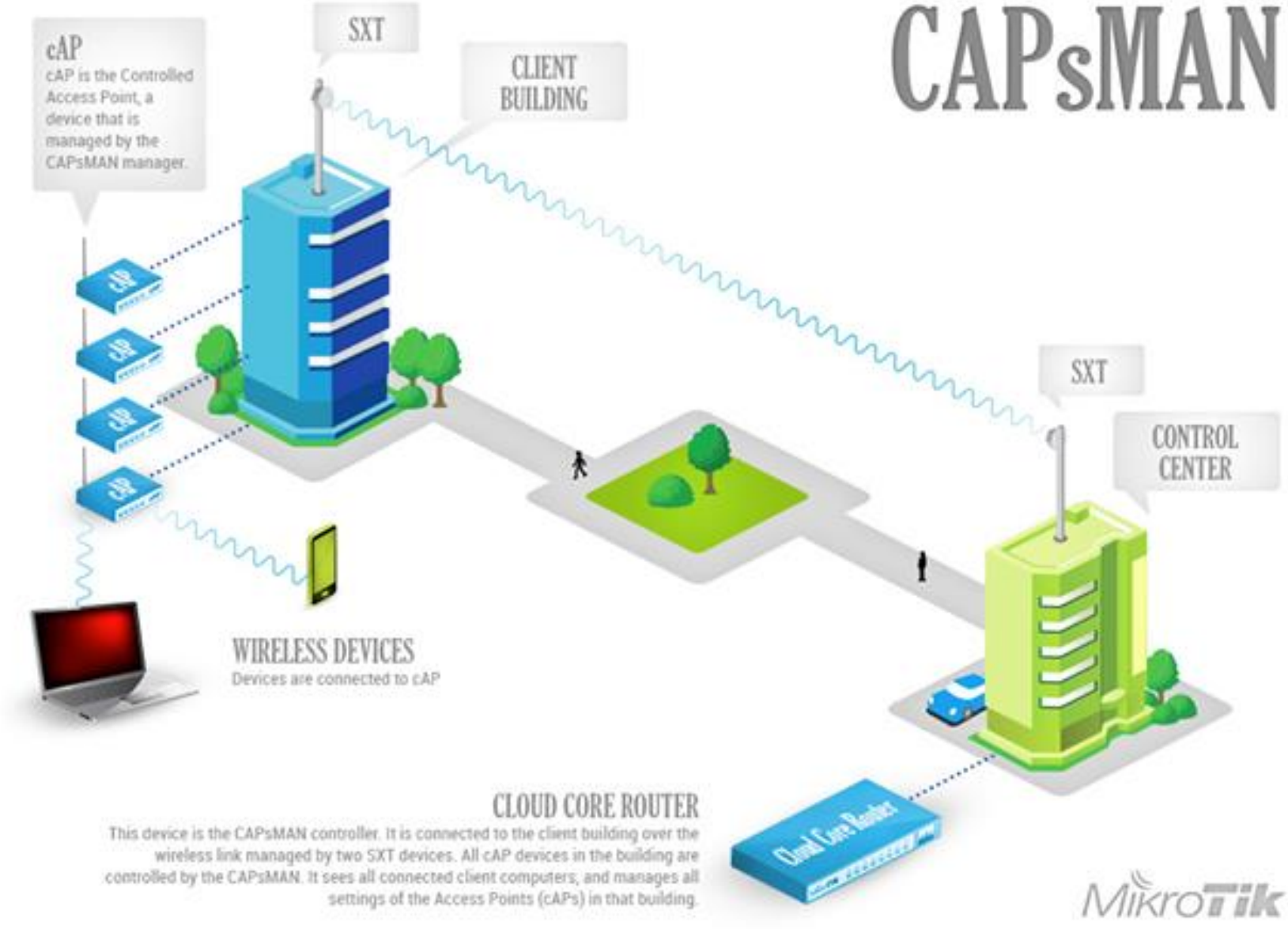
- Plan the coverage overlapping and frequency non-overlapping; using excel sheet for example.
- Using 4 channel scenario: better.



CAPs, RouterBOARDs, POE, CAPsMAN



CAPsMAN


cAP
cAP is the Controlled Access Point, a device that is managed by the CAPsMAN manager.
SXT
CLIENT BUILDING
SXT
CONTROL CENTER
WIRELESS DEVICES
Devices are connected to cAP
CLOUD CORE ROUTER
This device is the CAPsMAN controller. It is connected to the client building over the wireless link managed by two SXT devices. All cAP devices in the building are controlled by the CAPsMAN. It sees all connected client computers, and manages all settings of the Access Points (cAPs) in that building.
MikroTik

CAPsMAN for centralized management

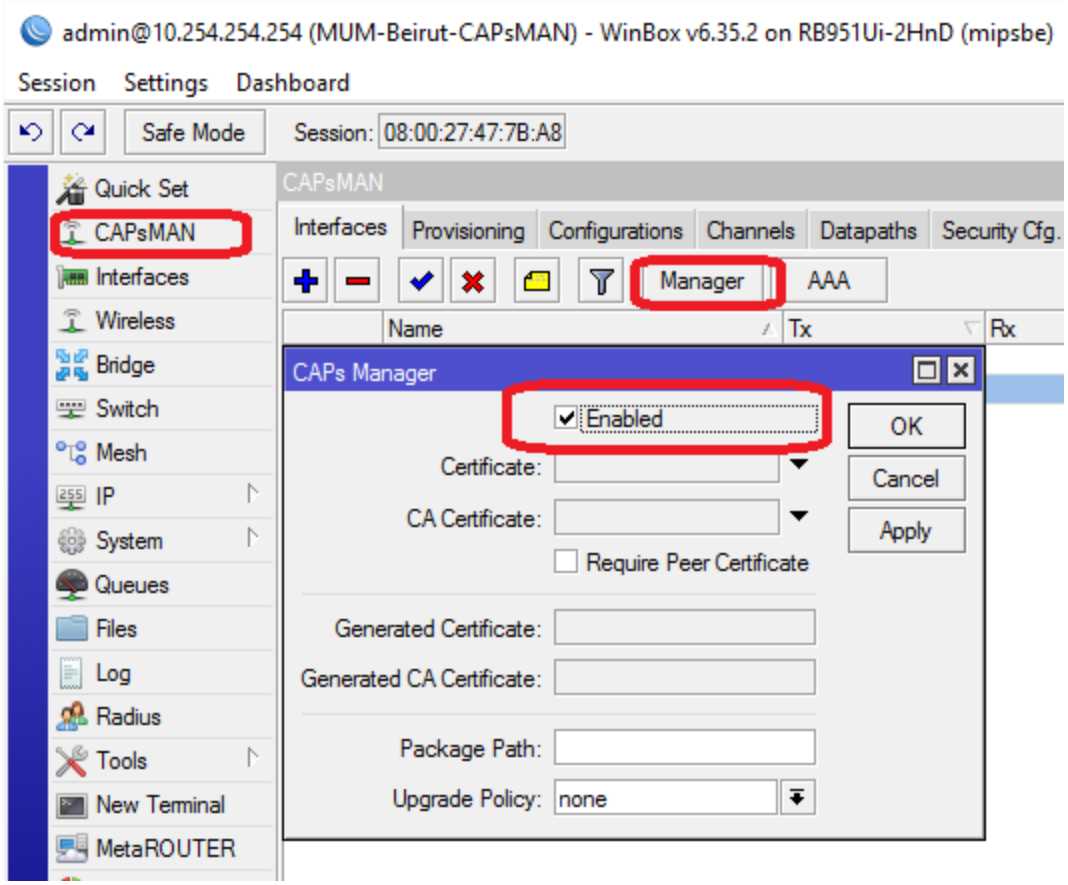
- CAP: Controlled Access Point
- CAPsMAN: Controlled Access Point system MANager
  - Centralized management of RouterOS APs
  - Provisioning of Aps
  - Custom configuration support
- CAPsMAN version 2:
  - Improved version
  - Available with latest RouterOS releases
  - wireless-cm2 package on all CAPs and CAPsMAN RouterBOARDs
- Since release 6.35.2: **wireless-rep package**
  - **CAPsMAN additional settings enabled**
  - **CAPsMAN Rates support**

Steps

- Enable CAPsMAN service
- Create Bridge interface and Add IP configuration
- Create CAPsMAN Configuration (rates, security…)
- Create Provisioning rule
- Enable CAP mode on the Aps
- Add entries to Access List

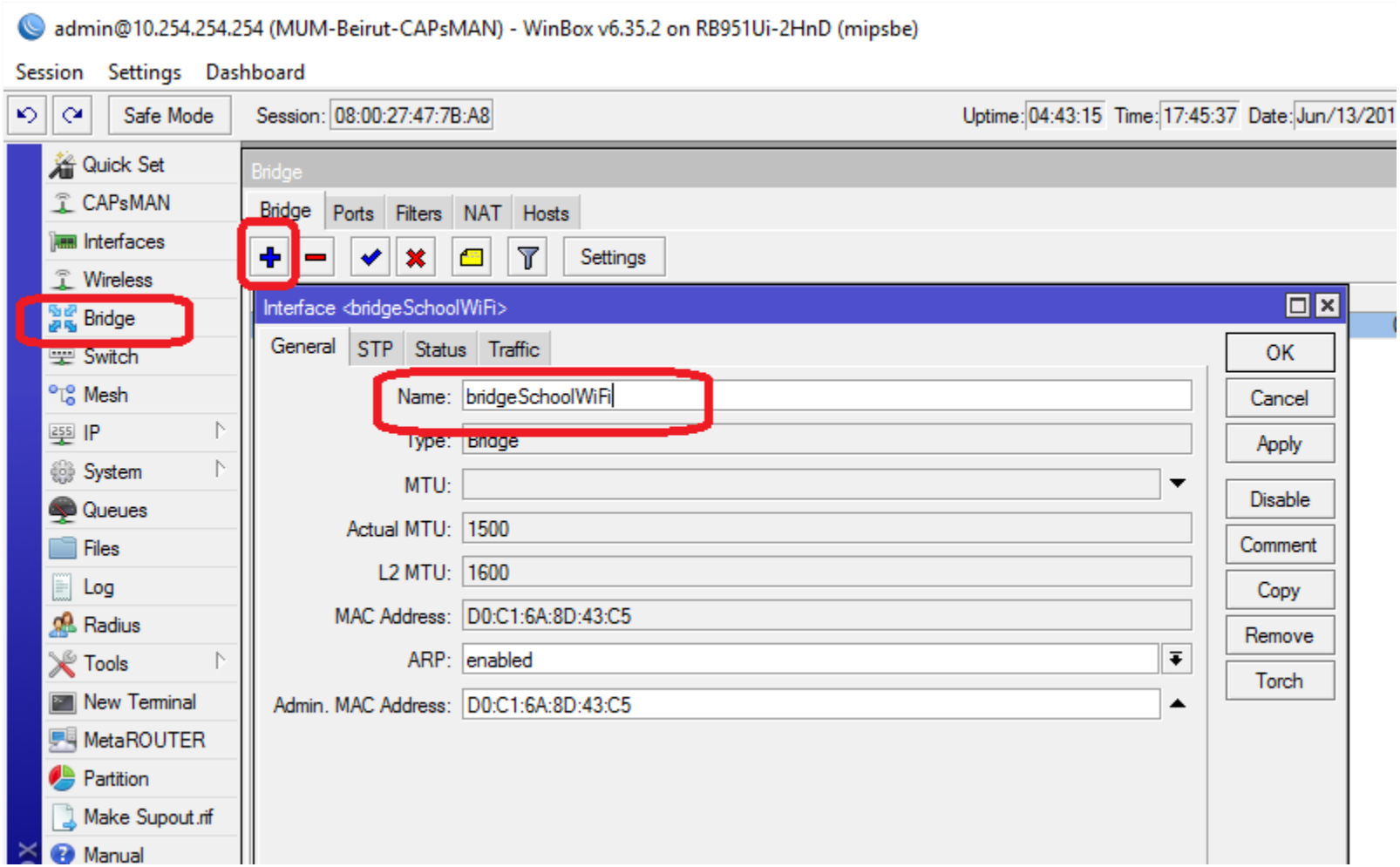
CAPsMAN Configuration: Step 1

- Enable CAPsMAN service
  - /caps-man manager set enabled=yes



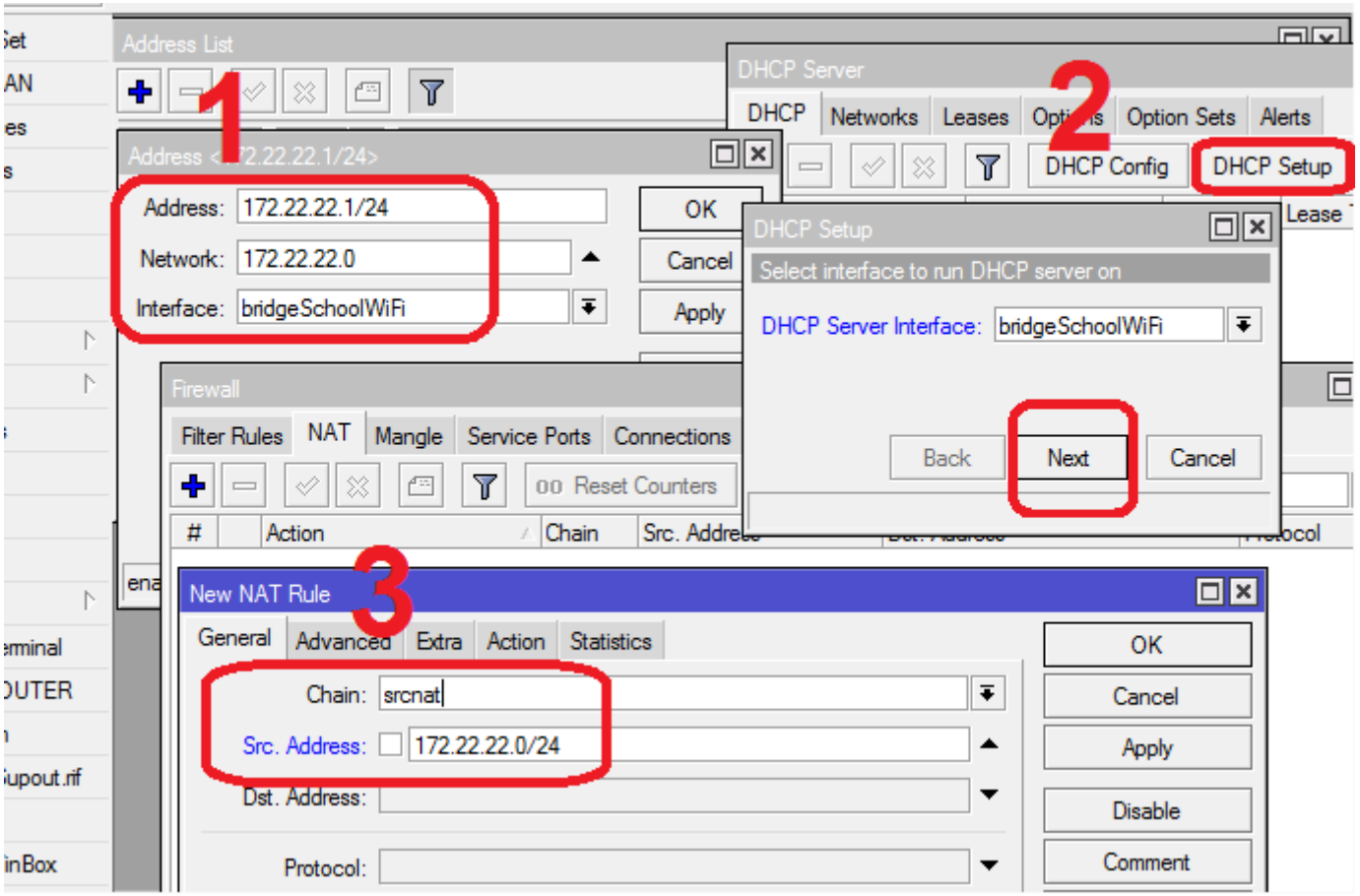
CAPsMAN Configuration: Step 2

- Create Bridge interface
  - /interface bridge add name=bridgeSchoolWiFi



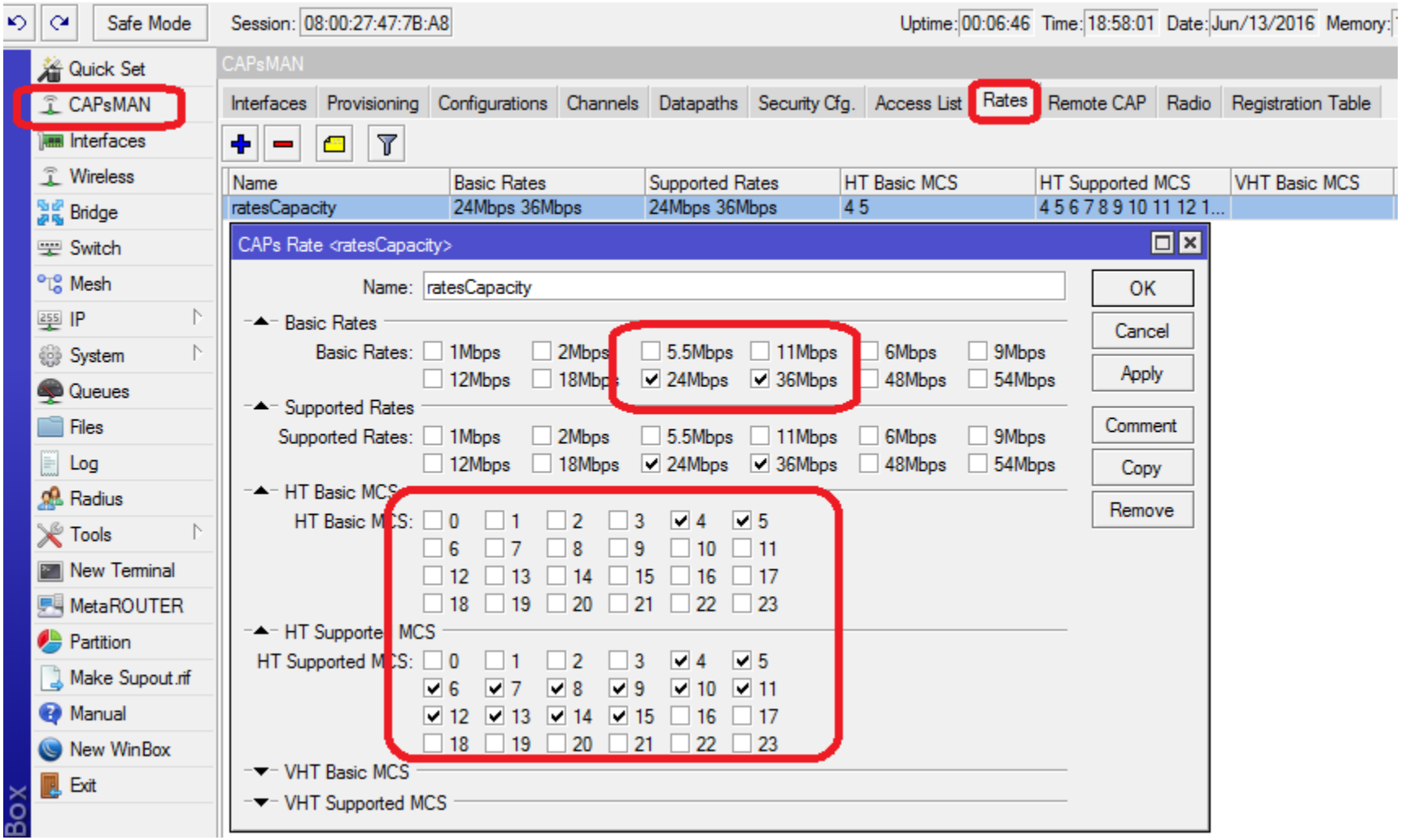
CAPsMAN Configuration: Step 3

- Add IP configuration to Bridge interface
  - IP Address, DHCP Server, NAT Masquerade



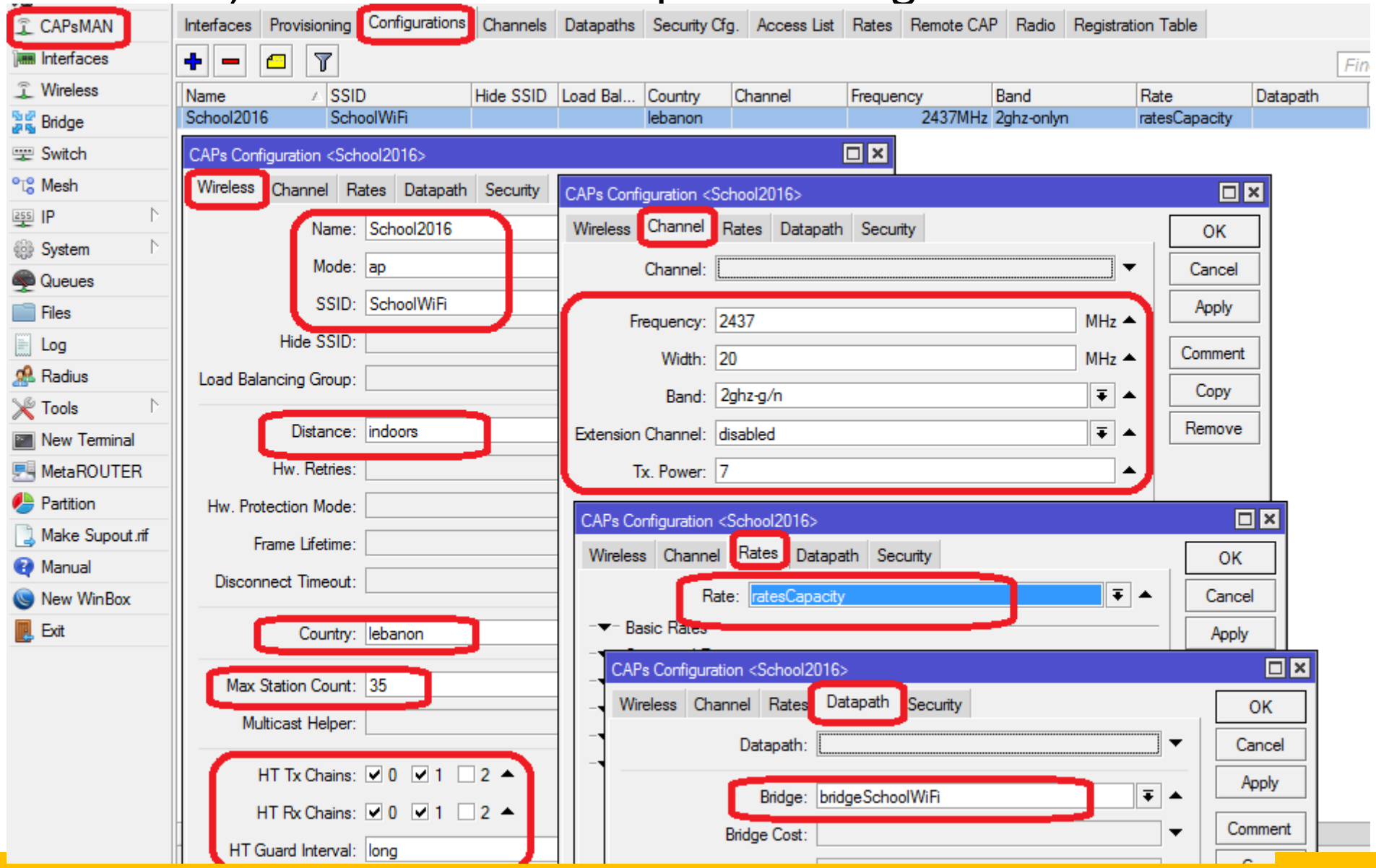
CAPsMAN Configuration: Step 4-Rates

- Rates tab available in “wireless-rep” package



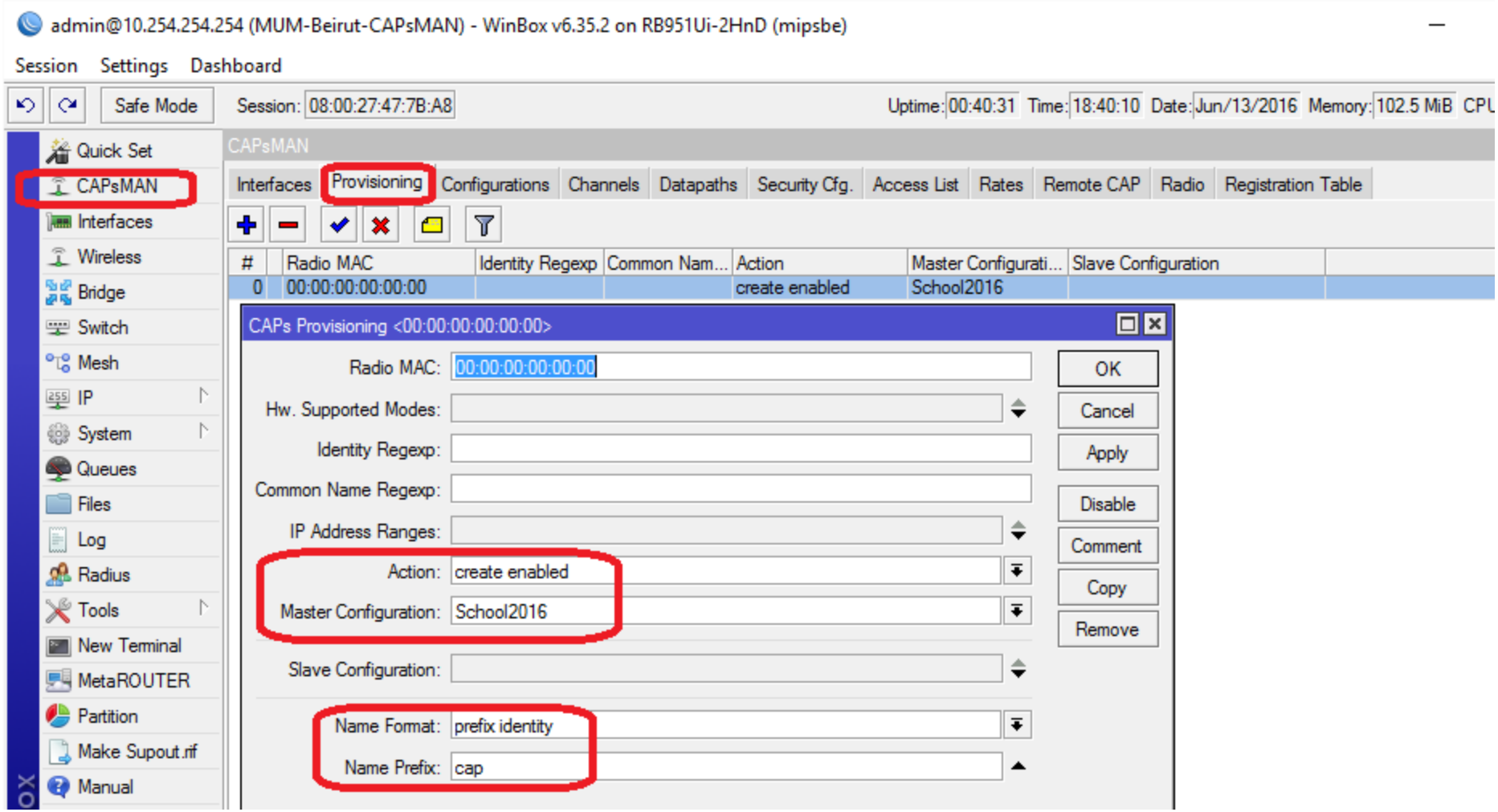
CAPsMAN Configuration: Step 4

- Wireless, Channel and Data path settings



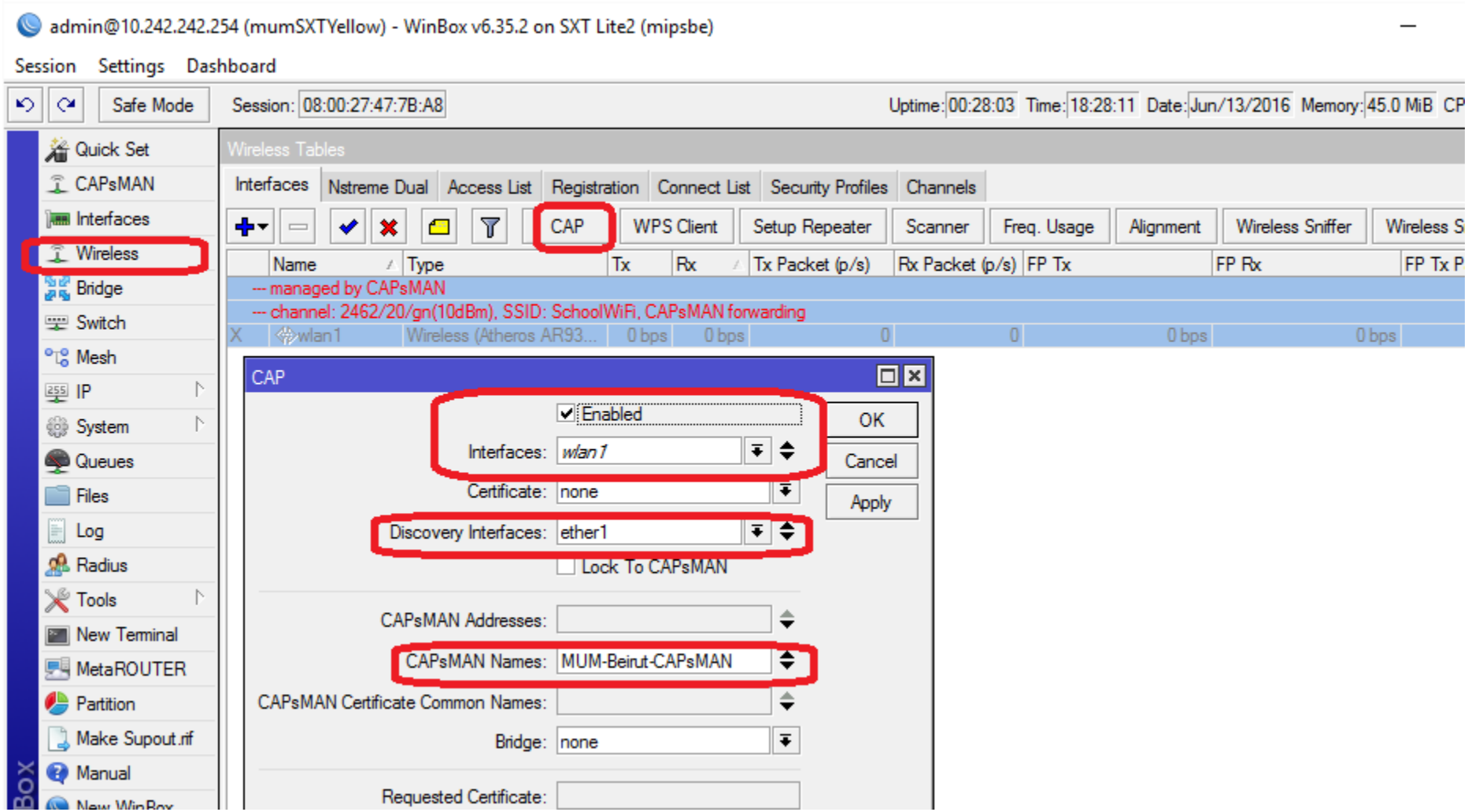
CAPsMAN Configuration: Step 5

- Create Provisioning rule



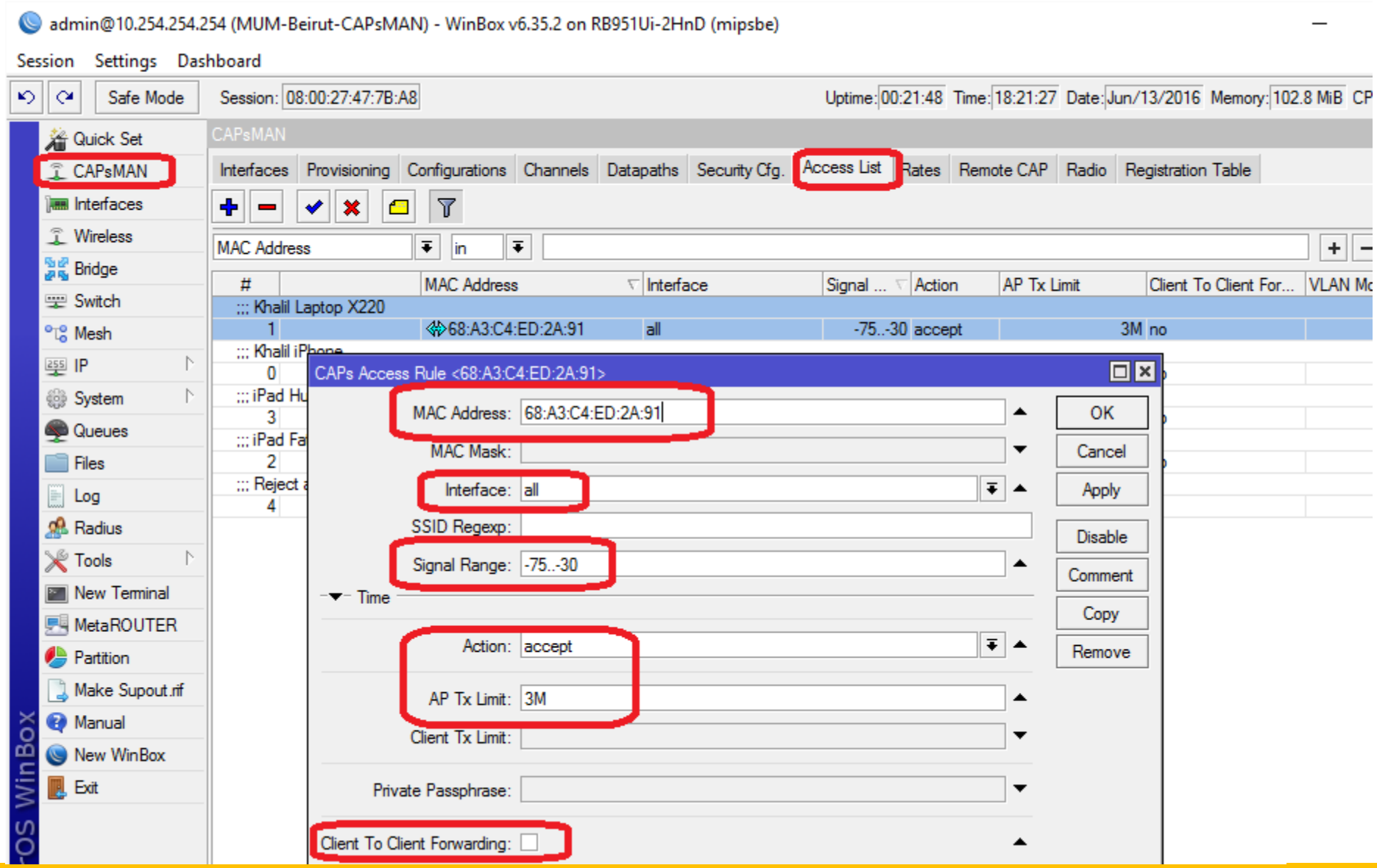
CAPsMAN Configuration: Step 6

- Enable CAP mode on the Aps
  - Effective settings from CAPsMAN shown in red

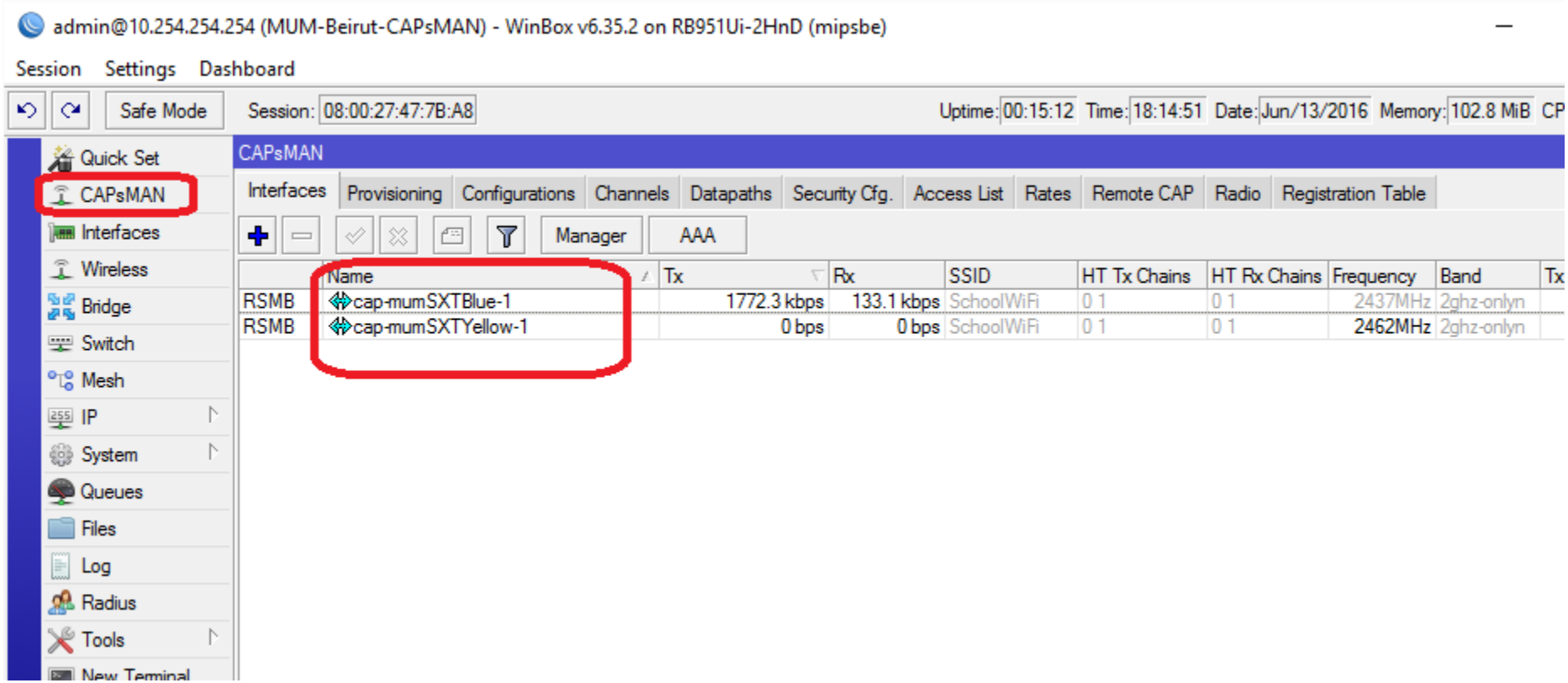


CAPsMAN Configuration: Step 7

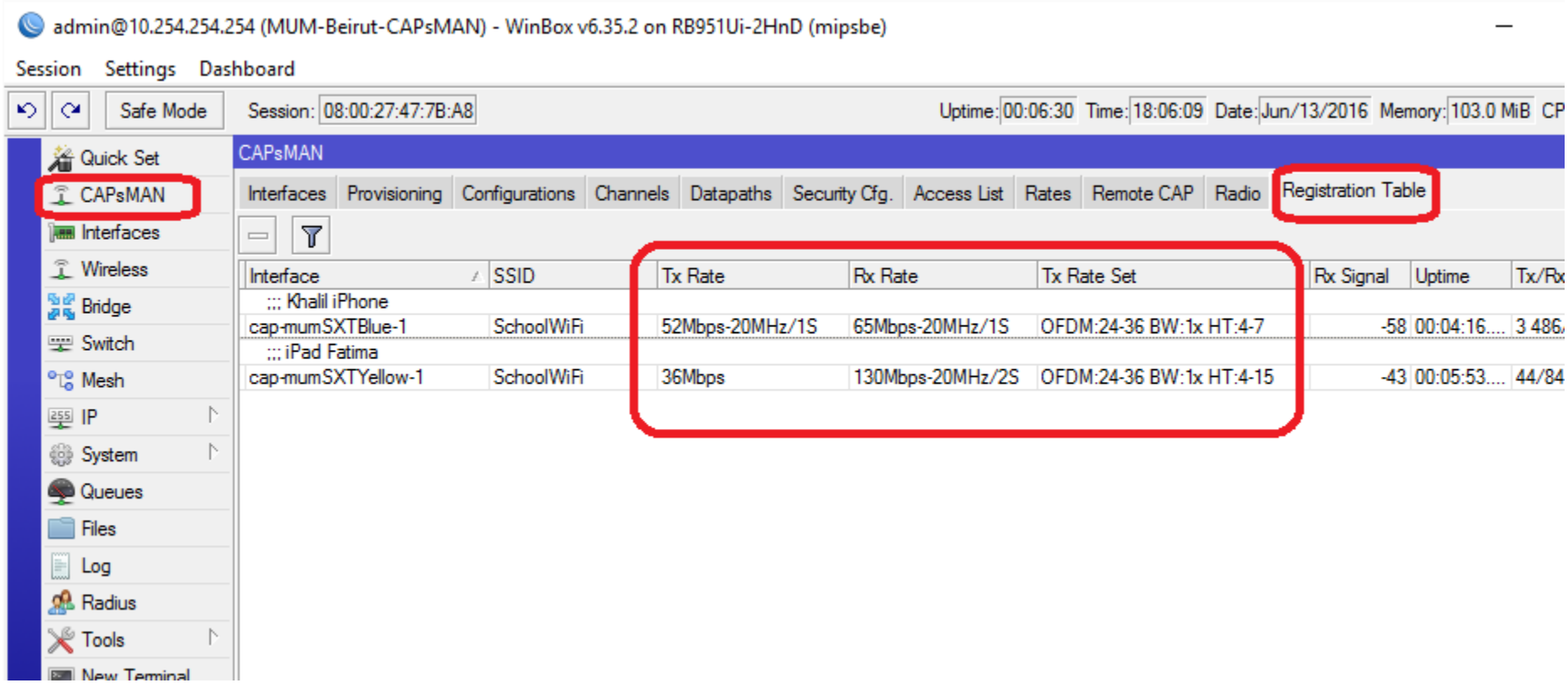
- Add entries to Access List



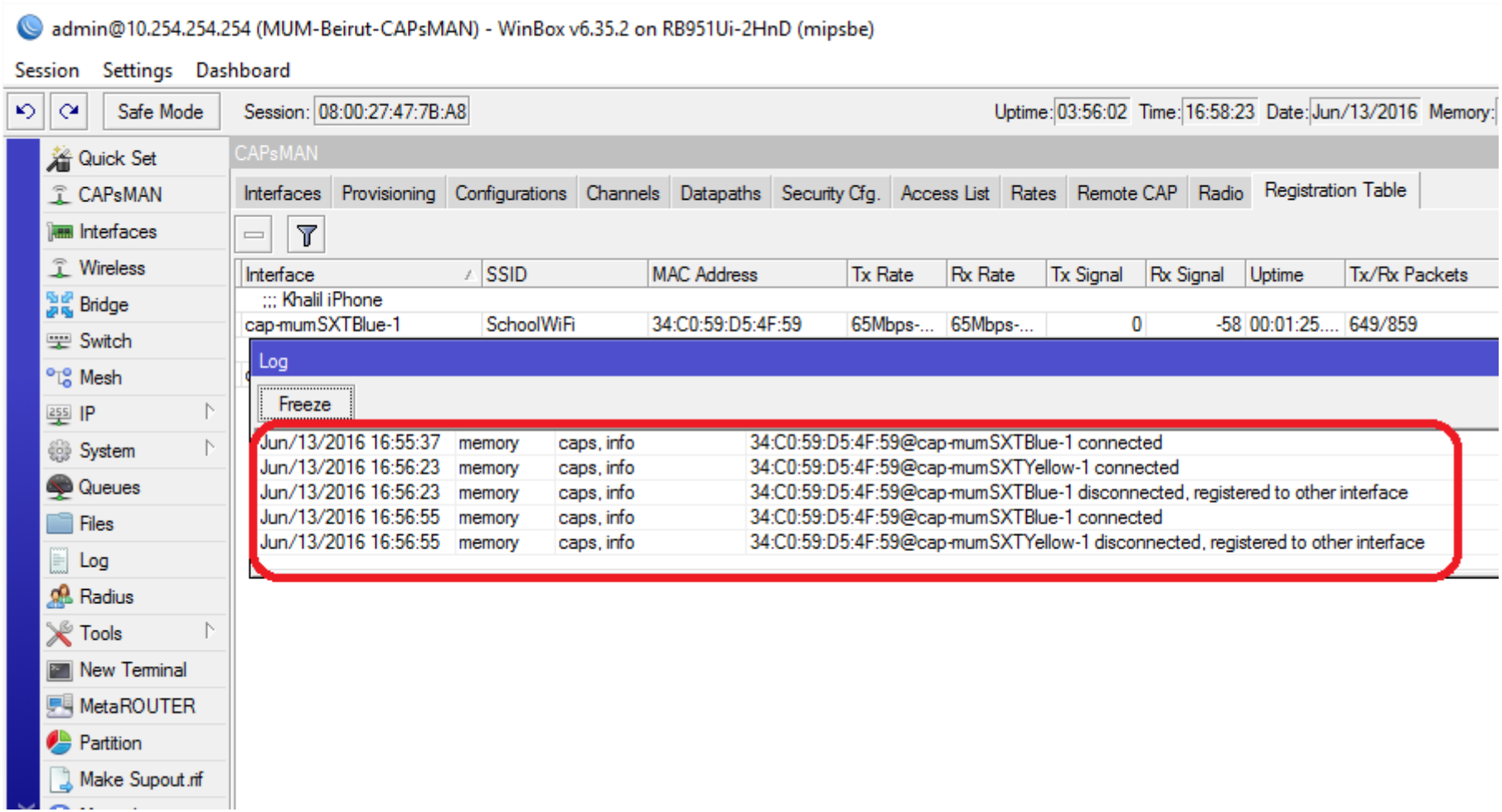
CAPsMAN Interfaces



CAPsMAN Registration Table



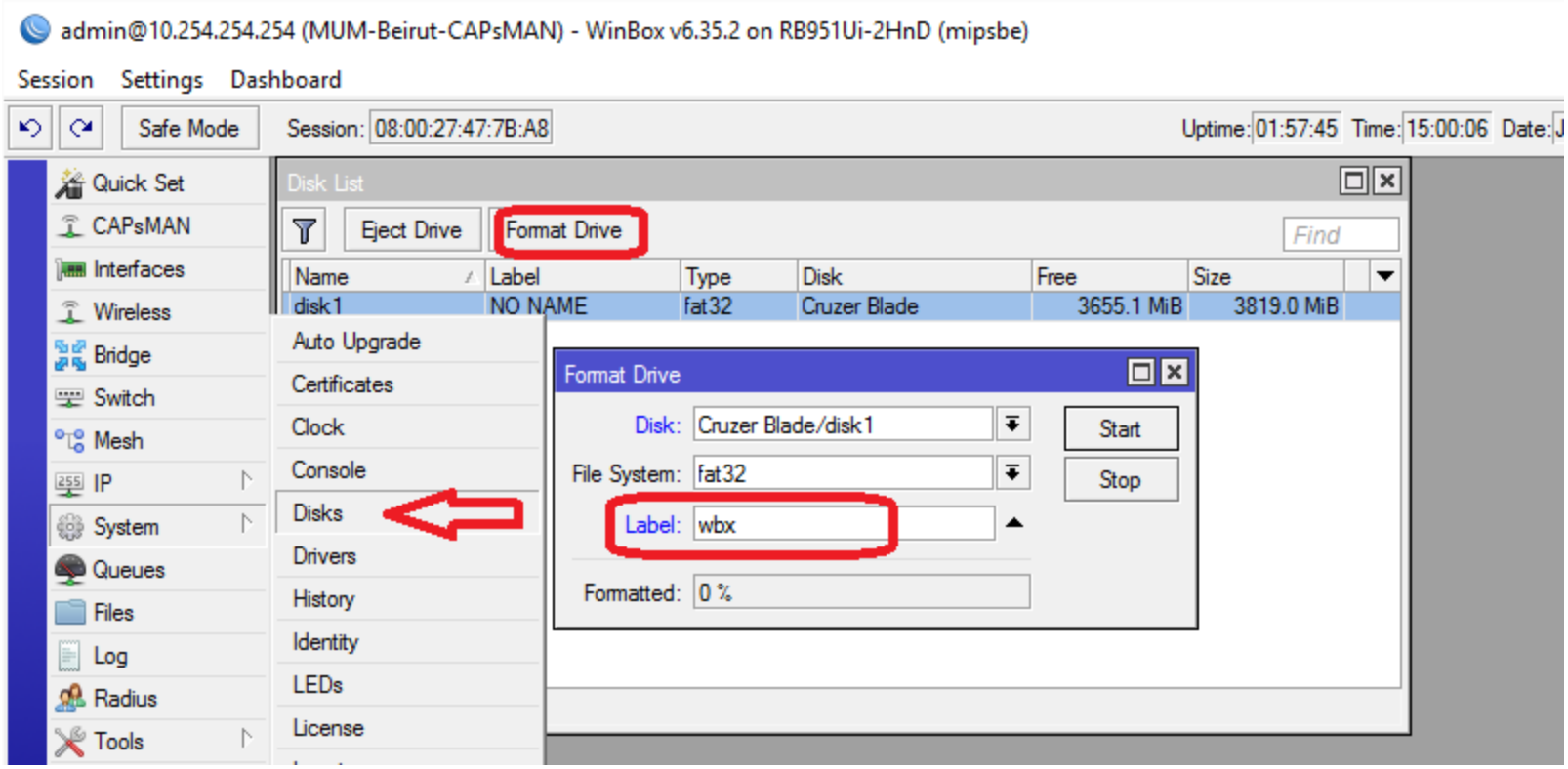
CAPsMAN: Coverage overlapping



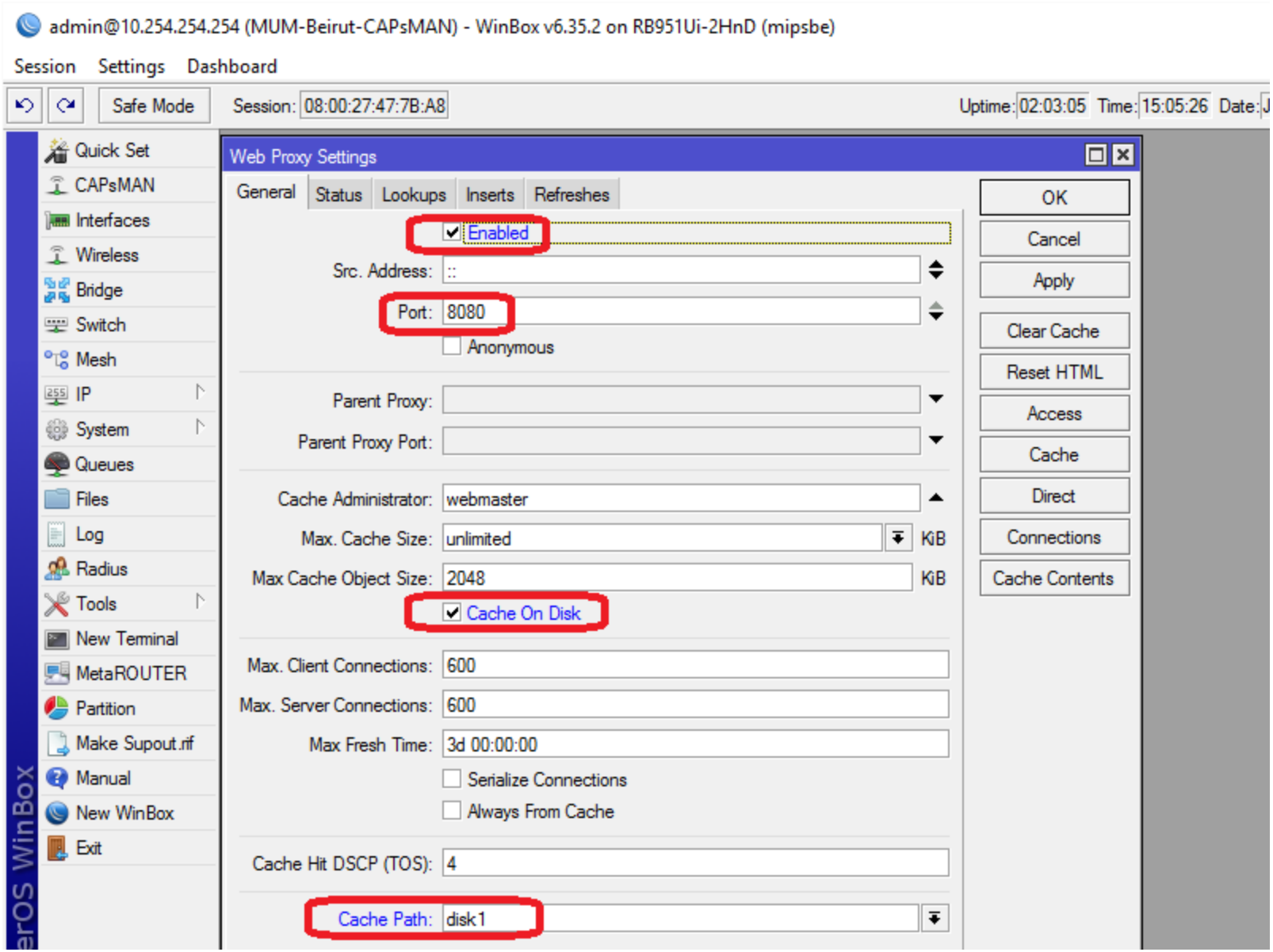
Web Proxy Simple Config

Web Proxy, Prepare Disk

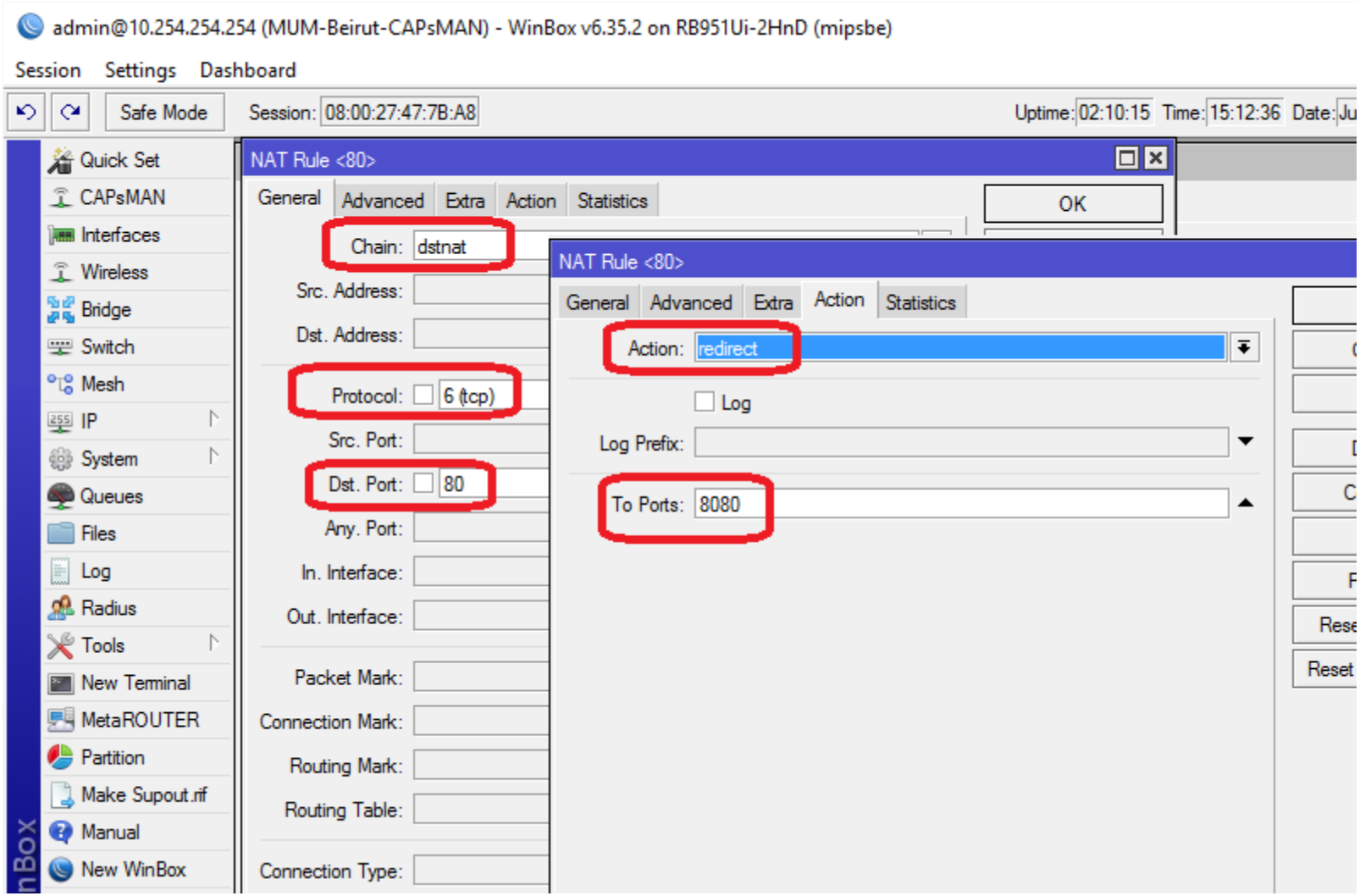
- Prepare Hard Disk, USB



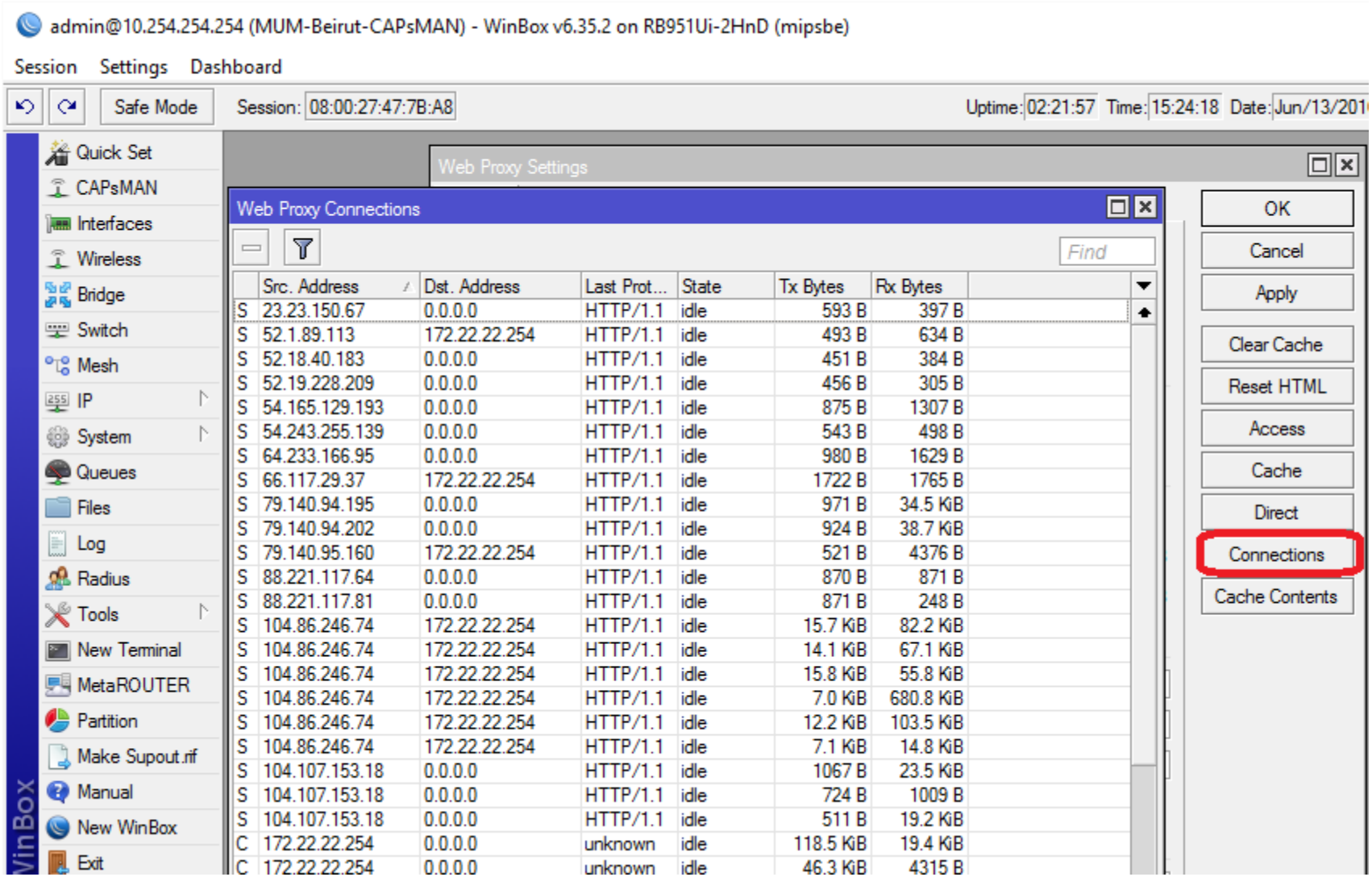
Web Proxy, Enable



Web Proxy, Transparent Redirect

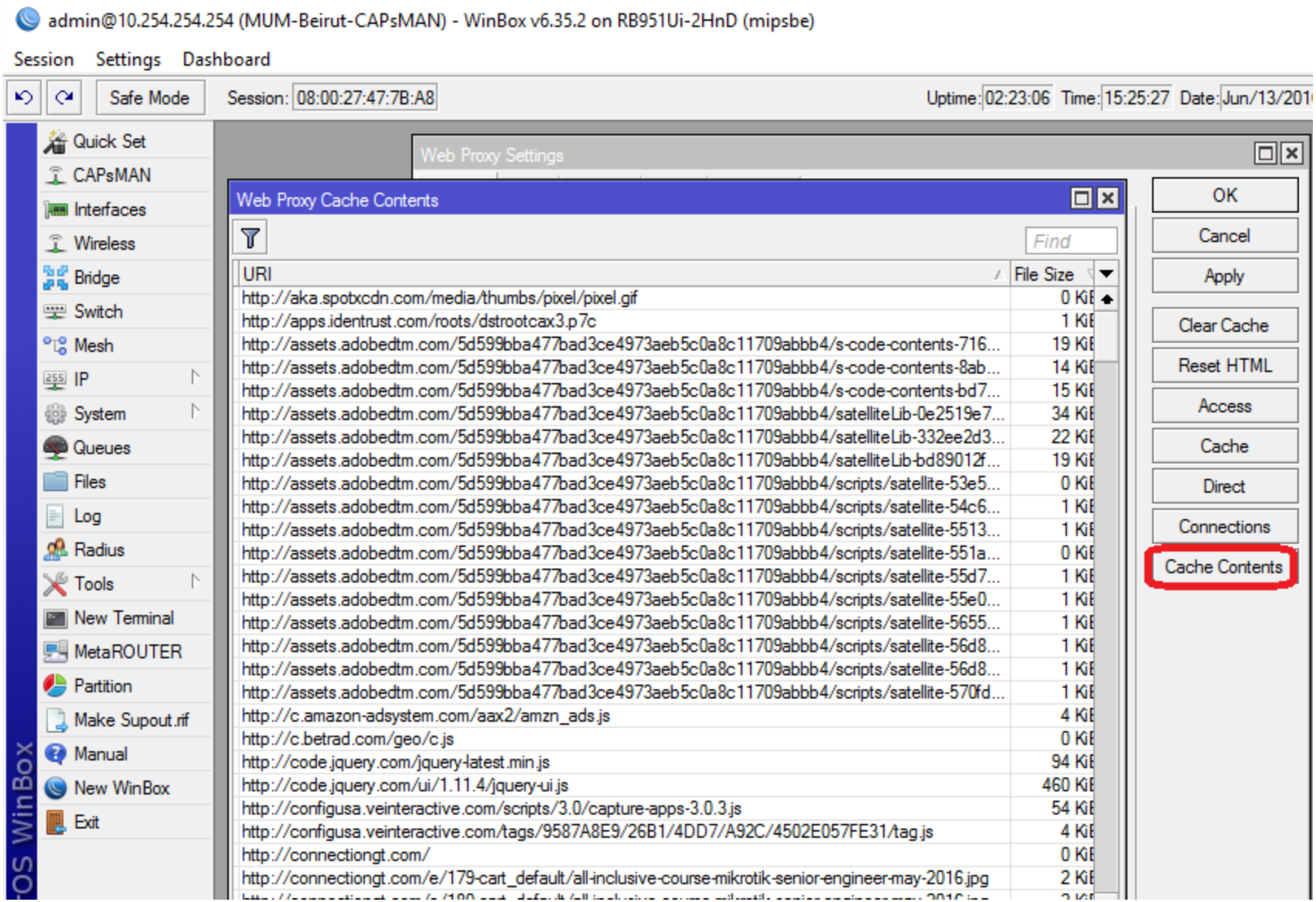


Web Proxy, Check Connections

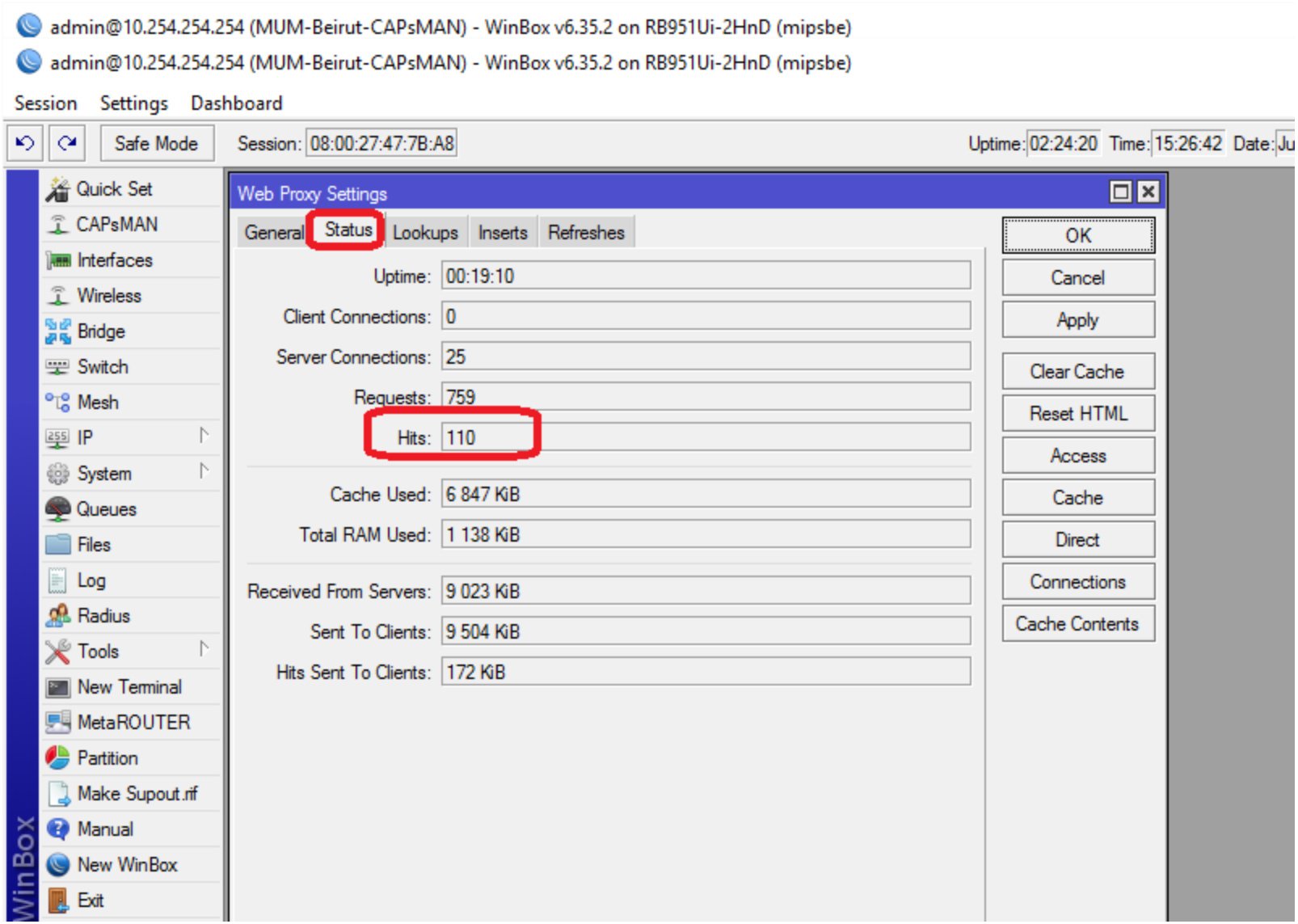


	Src. Address	Dst. Address	Last Prot...	State	Tx Bytes	Rx Bytes
S	23.23.150.67	0.0.0.0	HTTP/1.1	idle	593 B	397 B
S	52.1.89.113	172.22.22.254	HTTP/1.1	idle	493 B	634 B
S	52.18.40.183	0.0.0.0	HTTP/1.1	idle	451 B	384 B
S	52.19.228.209	0.0.0.0	HTTP/1.1	idle	456 B	305 B
S	54.165.129.193	0.0.0.0	HTTP/1.1	idle	875 B	1307 B
S	54.243.255.139	0.0.0.0	HTTP/1.1	idle	543 B	498 B
S	64.233.166.95	0.0.0.0	HTTP/1.1	idle	980 B	1629 B
S	66.117.29.37	172.22.22.254	HTTP/1.1	idle	1722 B	1765 B
S	79.140.94.195	0.0.0.0	HTTP/1.1	idle	971 B	34.5 KiB
S	79.140.94.202	0.0.0.0	HTTP/1.1	idle	924 B	38.7 KiB
S	79.140.95.160	172.22.22.254	HTTP/1.1	idle	521 B	4376 B
S	88.221.117.64	0.0.0.0	HTTP/1.1	idle	870 B	871 B
S	88.221.117.81	0.0.0.0	HTTP/1.1	idle	871 B	248 B
S	104.86.246.74	172.22.22.254	HTTP/1.1	idle	15.7 KiB	82.2 KiB
S	104.86.246.74	172.22.22.254	HTTP/1.1	idle	14.1 KiB	67.1 KiB
S	104.86.246.74	172.22.22.254	HTTP/1.1	idle	15.8 KiB	55.8 KiB
S	104.86.246.74	172.22.22.254	HTTP/1.1	idle	7.0 KiB	680.8 KiB
S	104.86.246.74	172.22.22.254	HTTP/1.1	idle	12.2 KiB	103.5 KiB
S	104.86.246.74	172.22.22.254	HTTP/1.1	idle	7.1 KiB	14.8 KiB
S	104.107.153.18	0.0.0.0	HTTP/1.1	idle	1067 B	23.5 KiB
S	104.107.153.18	0.0.0.0	HTTP/1.1	idle	724 B	1009 B
S	104.107.153.18	0.0.0.0	HTTP/1.1	idle	511 B	19.2 KiB
C	172.22.22.254	0.0.0.0	unknown	idle	118.5 KiB	19.4 KiB
C	172.22.22.254	0.0.0.0	unknown	idle	46.3 KiB	4315 B

Web Proxy, Check Caching



Web Proxy, Check Status



Summary: Solution Layout

- Each class shall have one Access Point
- Use only 802.11n (2.4Ghz) and some 802.11g
- Use CAPsMAN to manage the Access Points
- Tweak the TX power, the data rates
  - Increase Capacity, Decrease Coverage
- Uses CAPsMAN Access List to set conditions for connected devices
- Use Web Proxy near the gateway to cache selected websites.

Thank you

Questions?