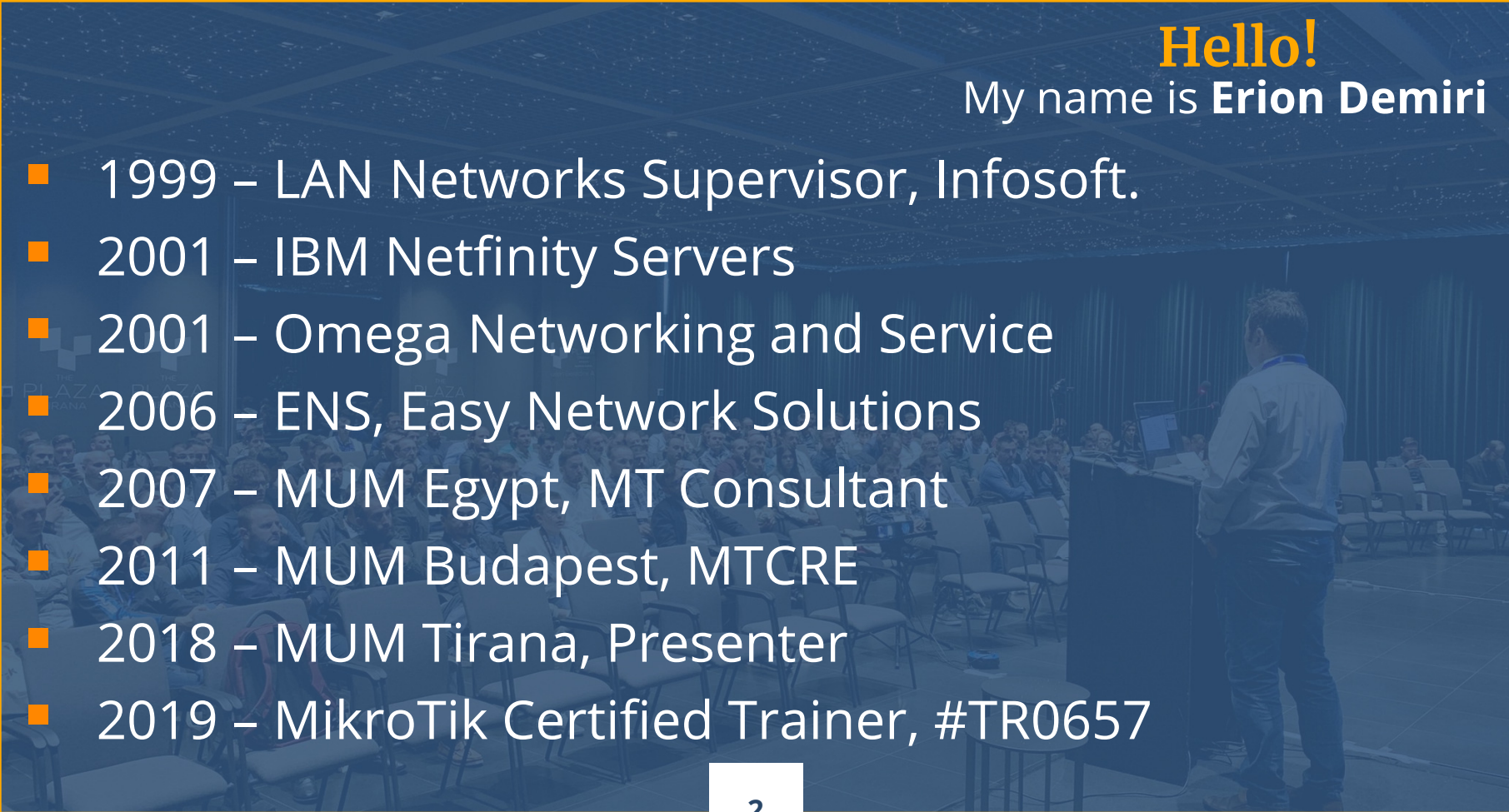


MikroTik Enterprise Wireless Networks

and

CAPsMAN

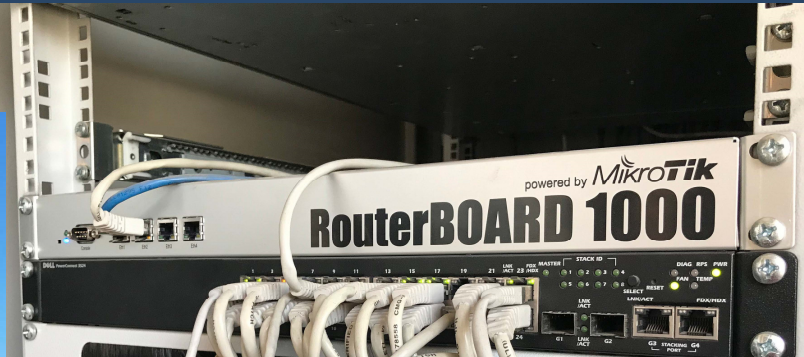




Hello!

My name is **Erion Demiri**

- 1999 – LAN Networks Supervisor, Infrosoft.
- 2001 – IBM Netfinity Servers
- 2001 – Omega Networking and Service
- 2006 – ENS, Easy Network Solutions
- 2007 – MUM Egypt, MT Consultant
- 2011 – MUM Budapest, MTCRE
- 2018 – MUM Tirana, Presenter
- 2019 – MikroTik Certified Trainer, #TR0657



PROJECTS



MikroTik

TRAINING CENTER



What are Wireless Networks

Why do we need them

Wireless Networks are everywhere

- (nearly) All mobile devices support them
- The preferred way of connecting to the internet by most people
- Offer liberty of movement
- Go, where no wire can go.



How did it all come to be.

- First we created networks with just one AP.
- The need of expansion of such networks, brought the **idea** of **BIGGER** more powerful APs.
- This didn't work as expected!
Reasons?
- We started adding more and more APs to these networks.





We created MONSTERS!

Sárkányok



Why Enterprise Wireless Networks

- Multiple Access Points are needed for multiple areas to cover
- Necessity for higher bandwidth, and increasing interference, has brought the need for smaller APs
- The bigger the number of the APs, the **more difficult** is their control



Power is Nothing!

Without Control

“

MikroTik's Response to this is
CAPsMAN

Controlled Access Points
Manager

What is it?

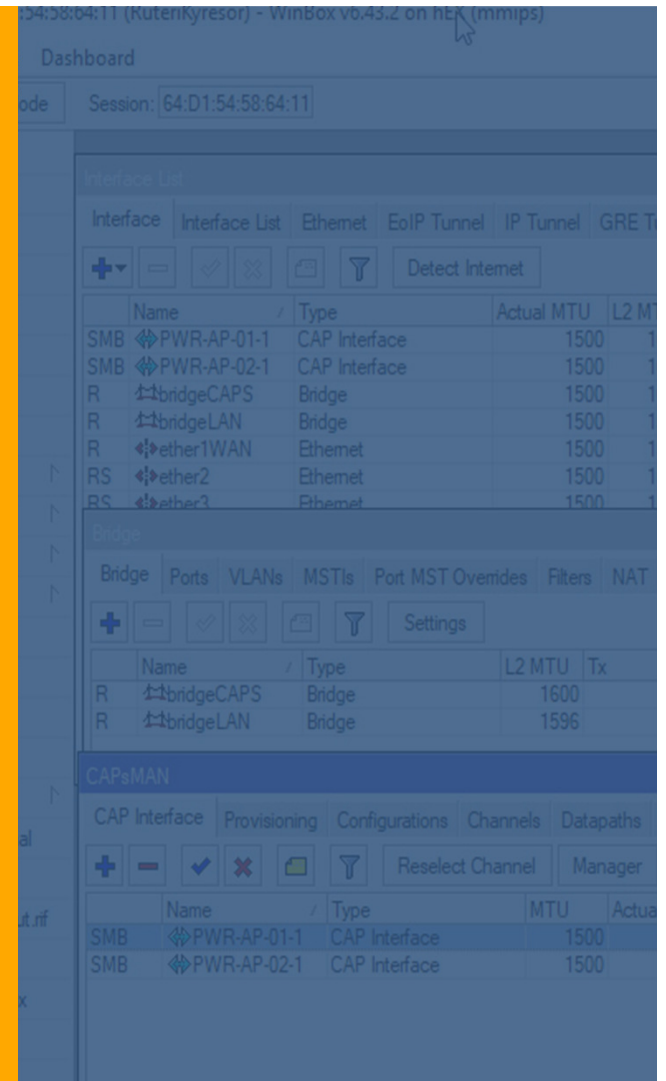
CAPsMAN, is a centralizing system by MikroTik. It gives the possibility to create a system of controlled access points, called CAPs, by a Controller called CAPsManager.

It is completely **FREE** (as in free beer) and can be used with any Routerboard, and installed in X86 or CHR too.

Since its introduction in 2014, it has changed the way we plan, implement and expand wireless networks.

What is needed

- At least 1 **device**, with 1 wireless card
- Latest version of RouterOS, with level 4 License.



Simplest CAPsMAN

hAP Mini – a device I'm in love with.

It is the cheapest RB with 1 wireless card, and 3 Ethernet ports.



Bigger setup?

Durres Harbour Container Terminal:

Latitude: $41^{\circ} 17' 60.00''$ N
Longitude: $19^{\circ} 26' 60.00''$ E

27 Towers with 2-3 APs (SXT 2, SXT SA5)

27 x RB260GSP

1 x CSS326-24G-2S+RM

1 x CCR1009-7G-1C

Even BIGGER?

- 123 x wsAP ac Lite
- 10 x wAP ac
- 10 x cAP Ac
- 6 x CRS328-24P-4S+RM
- 1 x CCR1009-7G-1C



Hardware Used

Frequency

2.4GHZ

- +Supported from most devices
- +Passes obstacles easier
- +Goes far

- Only 3 non-overlapping channels (1/6/11)
- More interference
- More devices non 802.11

5GHZ

- +Much more non-overlapping channels
 - +Much less interference
 - +Less devices non 802.11 that use 5GHZ
- Less client devices that has 5GHZ ability

Hardware Used Environment

Indoor



cAP Lite (2.4)



wsAP ac lite (Dual Band)



cAP ac (Dual Band)

Outdoor



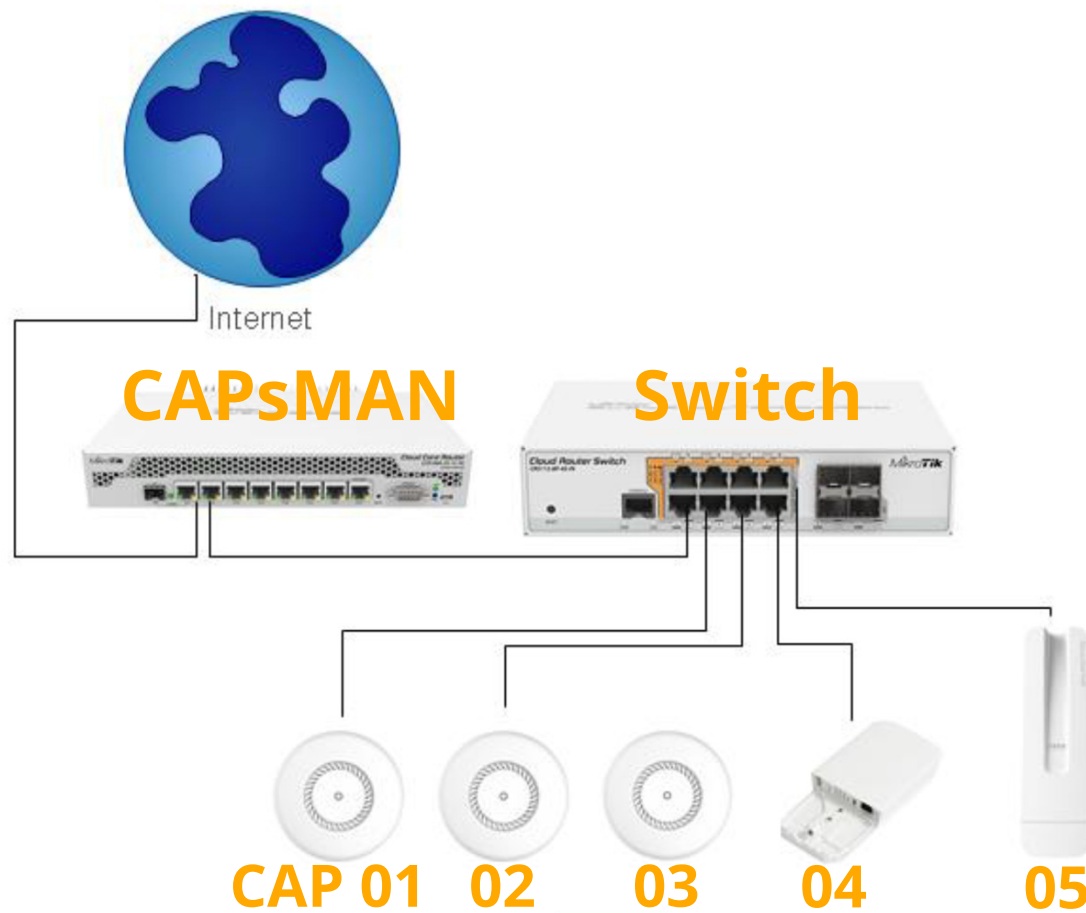
SXT2 & SXT SA5

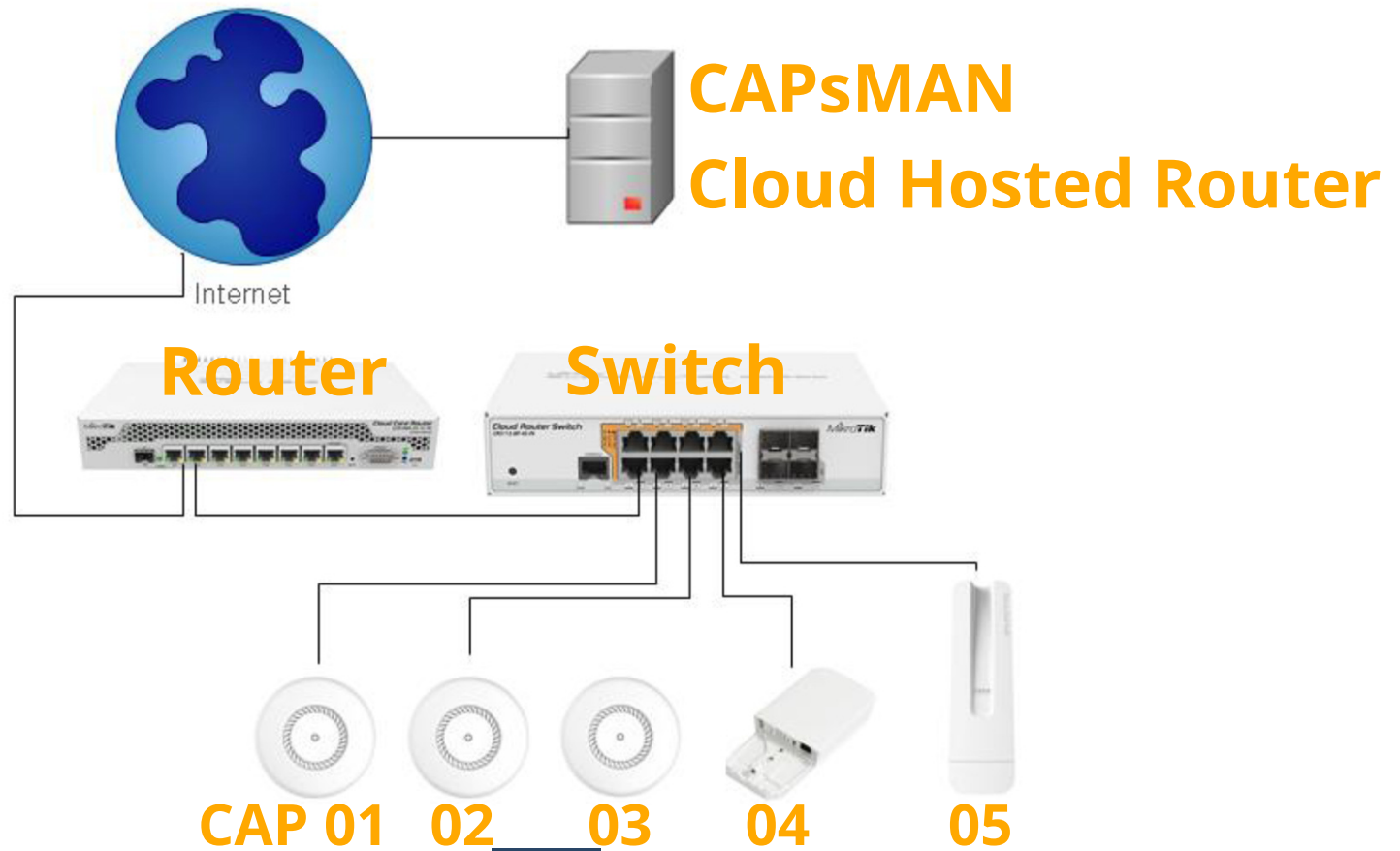


OmniTik 5ac



wAP ac Dual Band

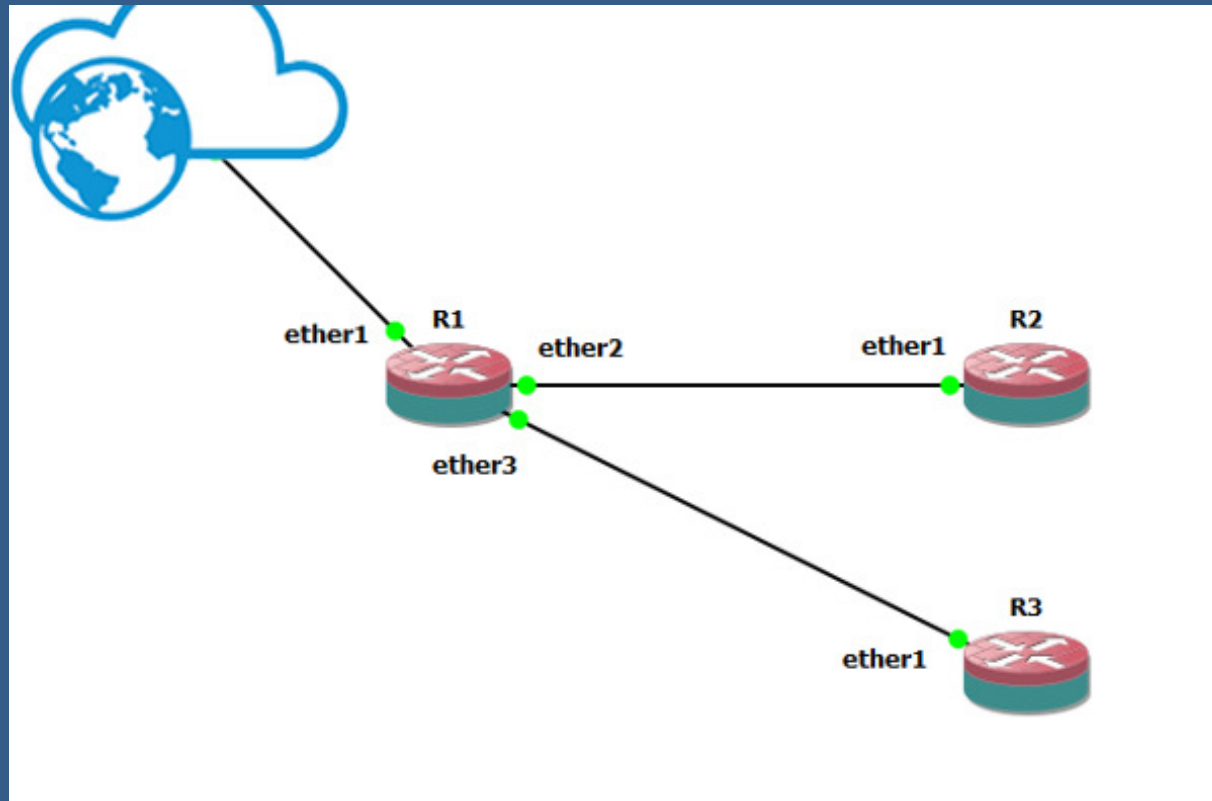




CAPsMAN

 in 5 minutes

Let us take in consideration the network diagram below



ensadmin@192.168.2.33 (TTT_CAPsMAN) - WinBox v6.43.12 on hAP ac lite (mipsbe)

Session Settings Dashboard

Safe Mode Session: 192.168.2.33

Quick Set
CAPsMAN
Interfaces
Wireless
Bridge
PPP
Switch
Mesh
IP
MPLS
OpenFlow
Routing
System
Queues
Files
Log
RADIUS
Tools
New Terminal
MetaROUTER

Interface List

Interface	Name	Type	Actual MTU	L2 MTU	Tx	Rx
R	bridge1	Bridge	1500	65535		0 bps
R	ether1Wan	Ethernet	1500	1598	80.5 kbps	11.0 kbps
R	ether2	Ethernet	1500	1598	0 bps	0 bps
	ether3	Ethernet	1500	1598	0 bps	0 bps
	ether4	Ethernet				
	ether5	Ethernet				
X	wlan1	Wireless (Atheros AR9...				
X	wlan2	Wireless (Atheros AR9...				

Address List

Address	Network	Interface
D 192.168.2.33/24	192.168.2.0	ether1Wan

DHCP Client

Interface	Use P...	Add D...	IP Address	Expires After	Stat
ether1Wan	yes	yes	192.168.2.33/24	23:56:15	bound

We take as granted that our R1 router already has internet access, through port Ether1

ensadmin@CC:2D:E0:28:58:45 (TTT_CAPsMAN) - WinBox v6.43.12 on hAP ac lite (mipsbe)

Session Settings Dashboard

Safe Mode Session: CC:2D:E0:28:58:45

Bridge

Bridge Ports VLANs MS

1 2 3 4

New Interface

General STP VLAN Status Traffic

Name: bridgeCAPS

Type: Bridge

MTU:

Actual MTU:

L2 MTU:

MAC Address:

ARP: enabled

ARP Timeout:

Admin. MAC Address:

Ageing Time: 00:05:00

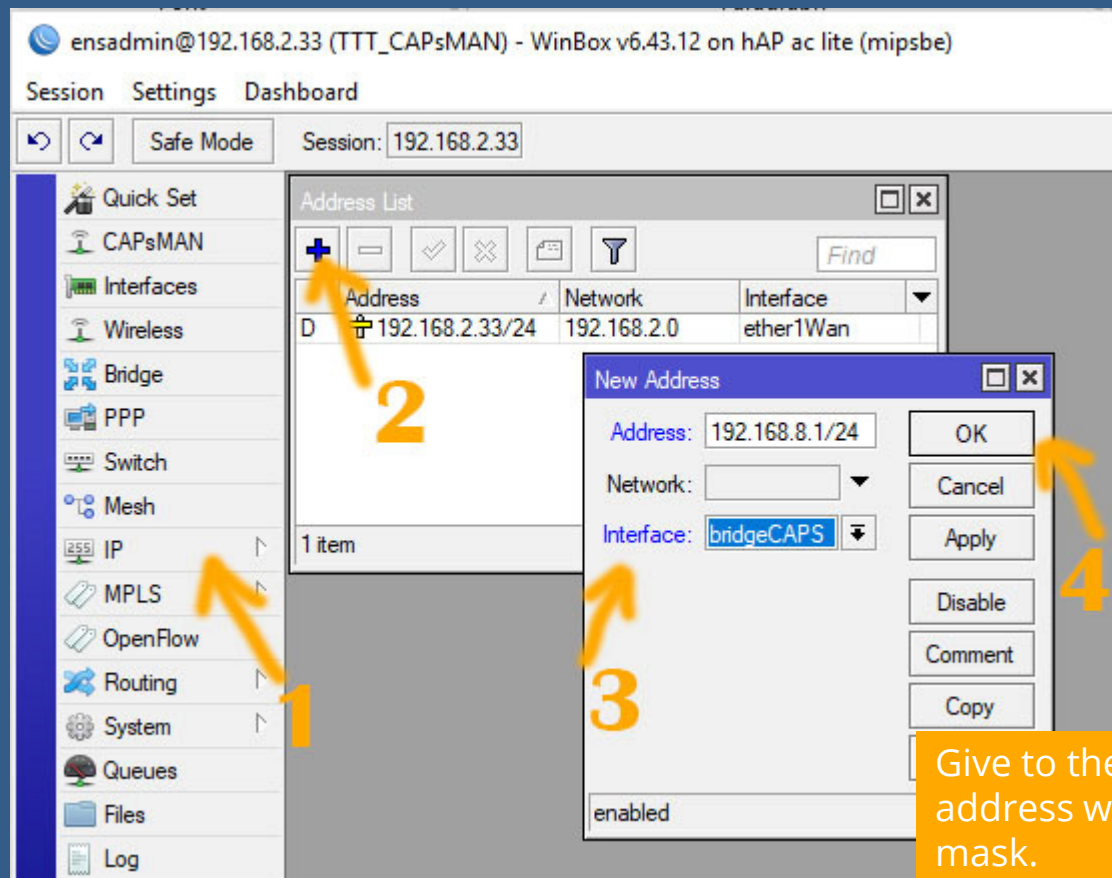
IGMP Snooping

DHCP Snooping

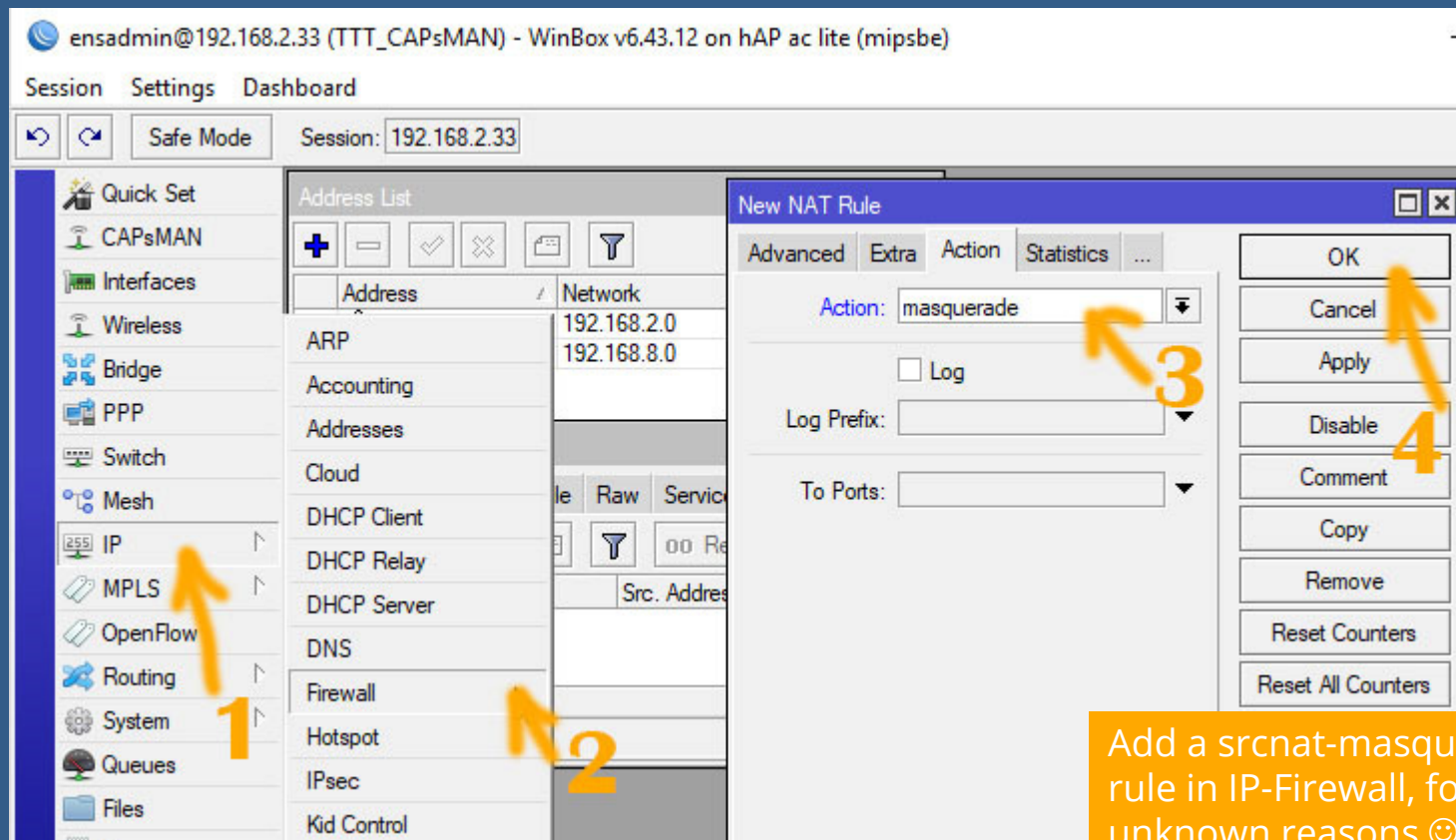
Fast Forward

OK Cancel Apply Disable Comment Copy Remove Torch

Create a bridge, that will have as ports all the wireless interfaces of our CAPs. It will serve as "datapath".



Give to the bridge an IP address with the desired mask.



Add a srcnat-masquerade rule in IP-Firewall, for unknown reasons ☺

ensadmin@192.168.2.33 (TTT_CAPsMAN) - WinBox v6.43.12 on hAP ac lite (mipsbe)

Session Settings Dashboard

Safe Mode Session: 192.168.2.33

Quick Set
CAPsMAN
Interfaces
Wireless
Bridge
PPP
Switch
Mesh
IP
MPLS
OpenFlow
Routing
System
Queues
Files
Log

ARP
Accounting
Addresses
Cloud
DHCP Client
DHCP Relay
DHCP Server
DNS
Firewall
Hotspot
IPsec
Kid Control
Neighbors

DHCP Server

DHCP Networks Leases Options Option Sets Alerts

+ - ✓ ✕ ⏏ DHCP Config DHCP Setup

Name	Interface	Relay	Lease Time
0 items			

1

2

3

Setup a DHCP-Server in the BridgeCAPS interface. It will serve IP addresses to the clients of the Wifi Network

ensadmin@192.168.2.33 (TTT_CAPsMAN) - WinBox v6.43.12 on hAP ac lite (mipsbe)

Session Settings Dashboard

Safe Mode Session: 192.168.2.33

1 CAPsMAN

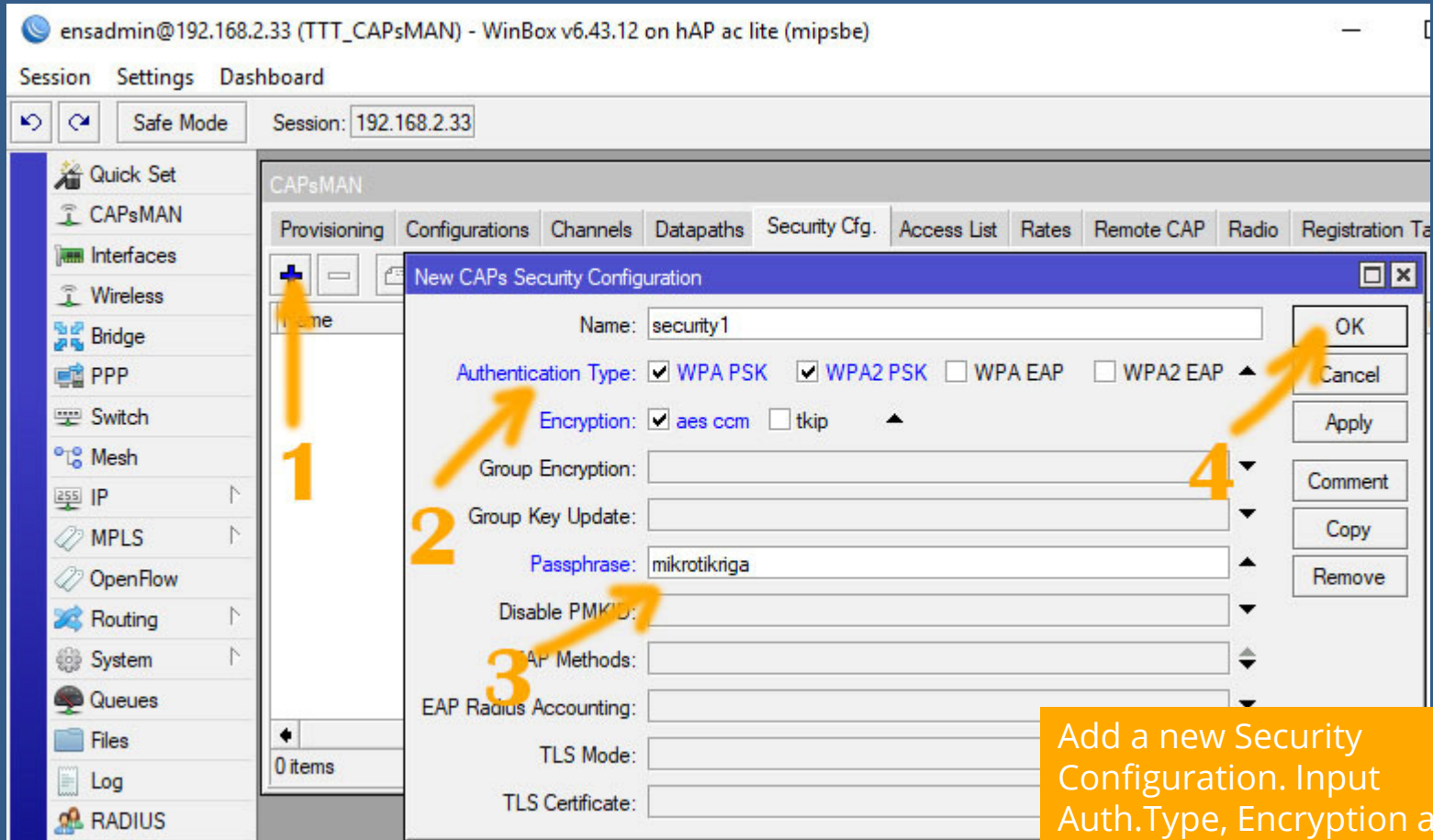
CAPsMAN

CAP Interface Provisioning Configurations Channels Datapaths Security Cfg. Access List Rates Remote CAP Radio ...

+ - ✓ ✕ [Icon] [Icon] Reselect Channel Manager [Icon] [Icon]

Name	Type	MTU	Actual MTU	2 MTU	Tx	Rx
0 items out of 9						

CAPsMAN Setup. Normally you start from right to left. Security Cfg. Tab can be the first.



Add a new Security Configuration. Input Auth.Type, Encryption and Passphrase

CAPsMAN

Provisioning

Configurations

Channels

Datapaths

Security Cfg.

Access List

Rates

Remote CAP

Radi

Name	Bridge	Open
------	--------	------

0 items		
---------	--	--

New CAPs Datapath Configuration

Name: datapath1

MTU:

L2 MTU:

ARP:

Bridge: bridgeCAPS

Bridge Cost:

Bridge Horizon:

OpenFlow Switch:

Local Forwarding:

Client To Client Forwarding:

OK

Cancel

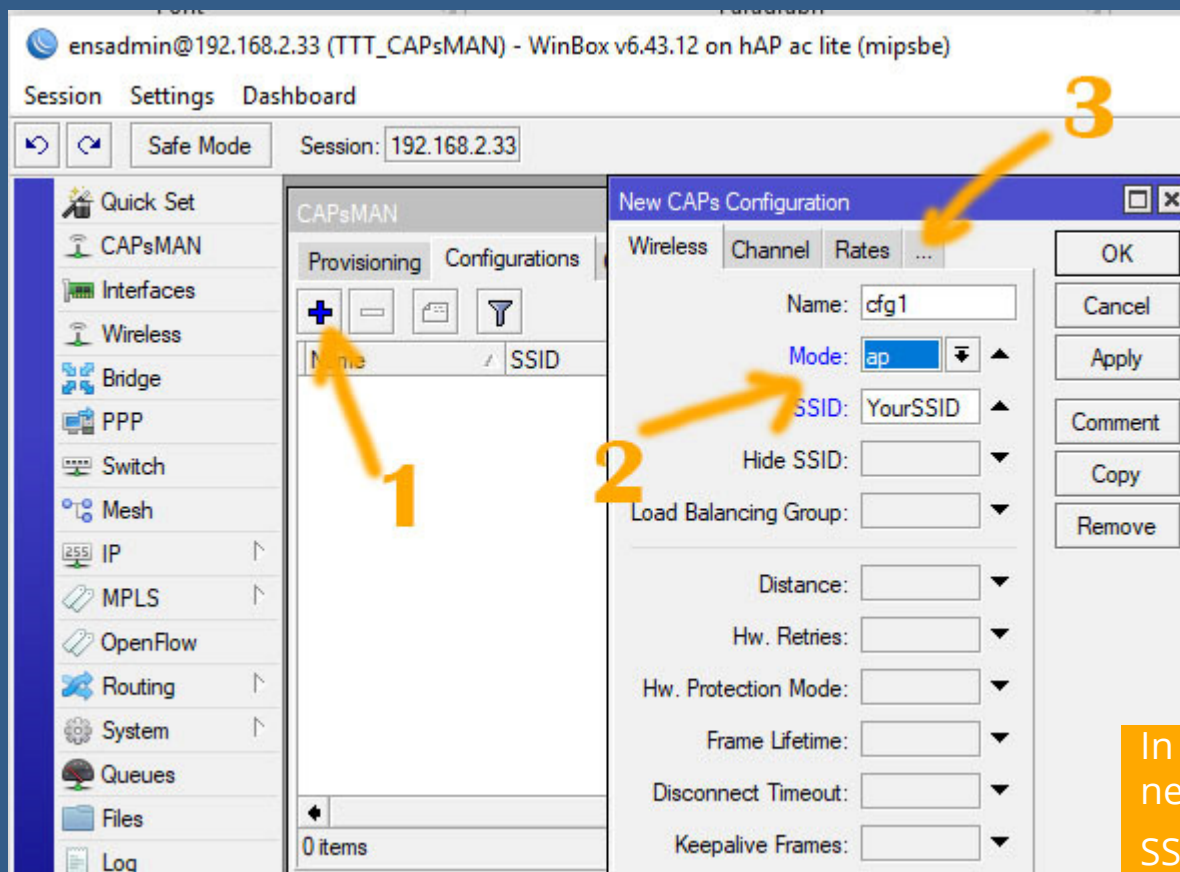
Apply

Comment

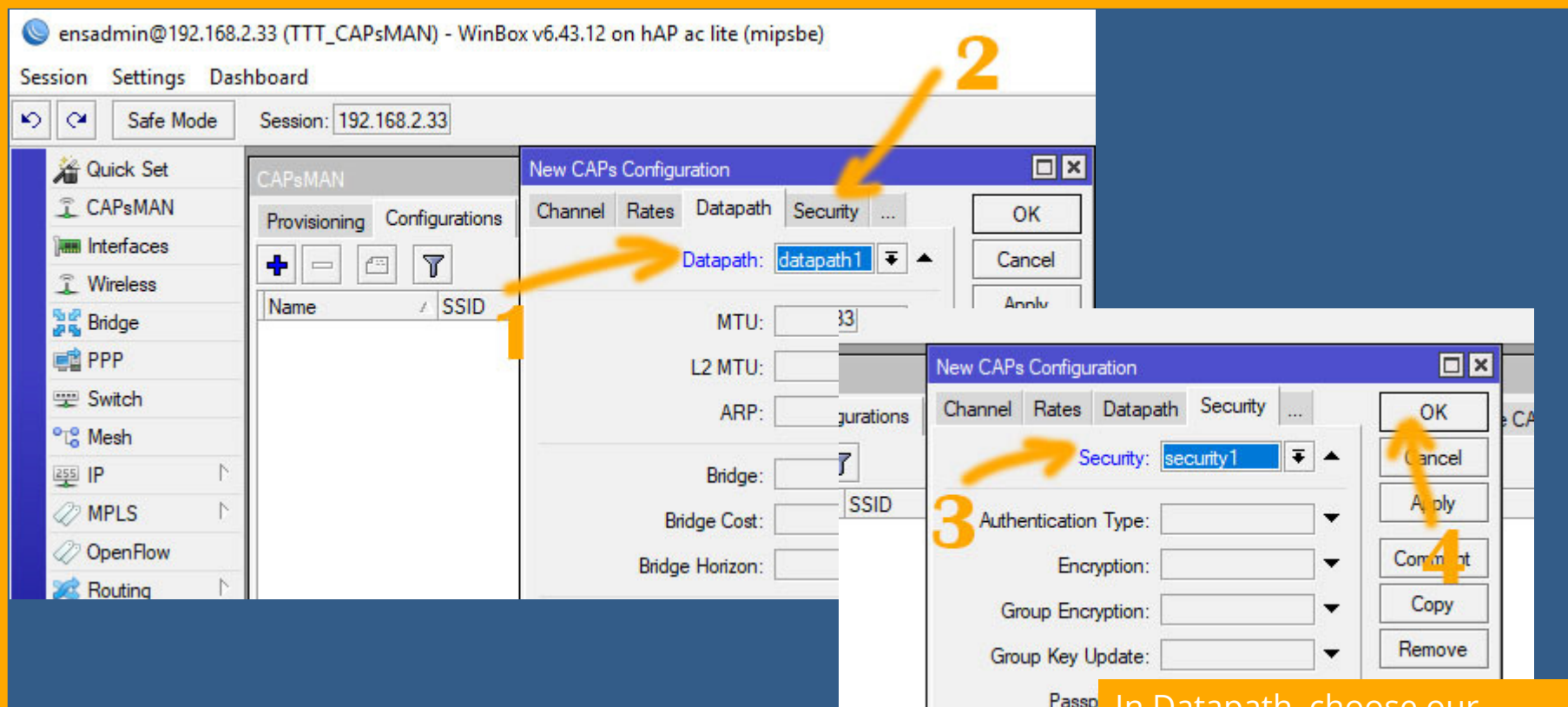
Copy

Remove

In Datapaths tab, add a new Datapath Config, input as Bridge our bridgeCAPS

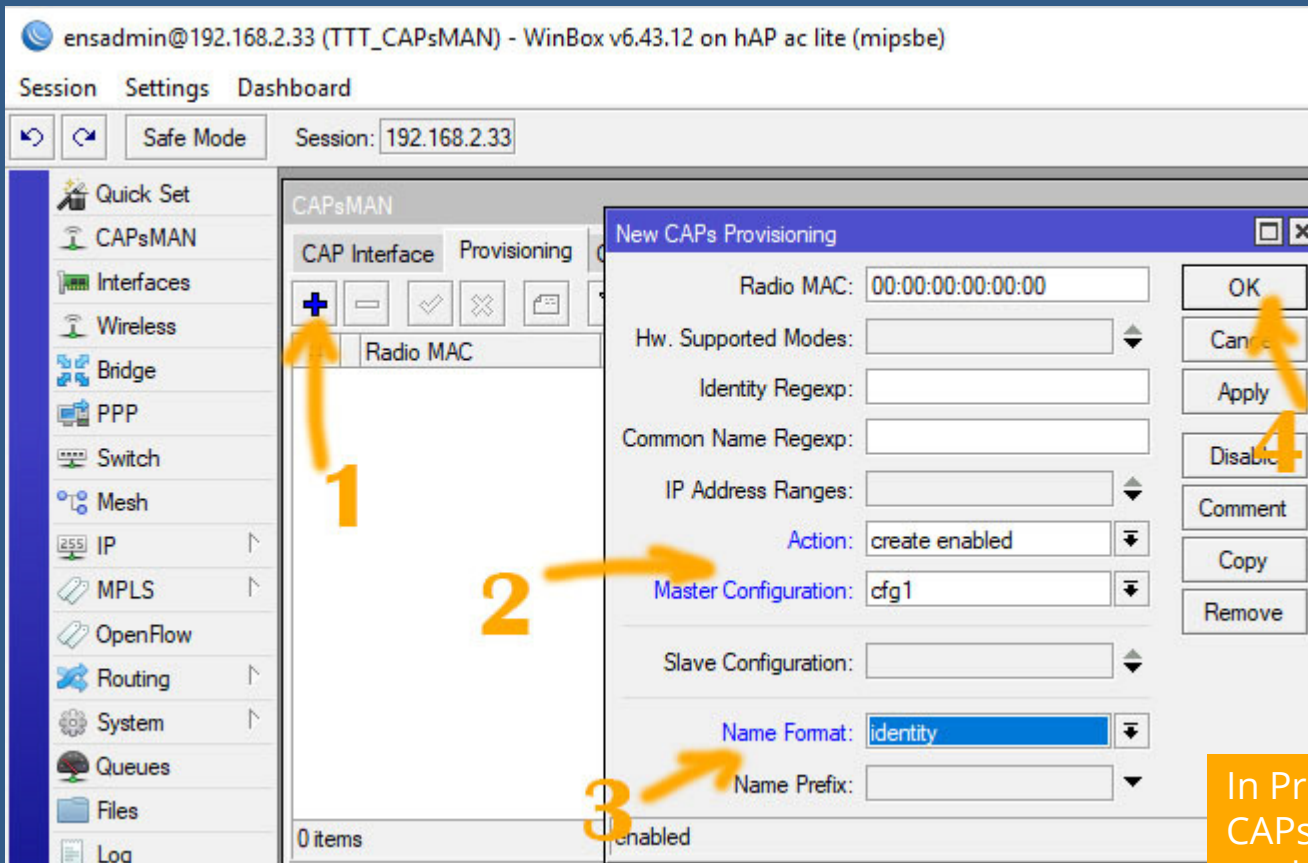


In Configurations tab, add a new config, Mode: ap, SSID: yourSSID. Don't press OK but go to tab Datapath in this window.

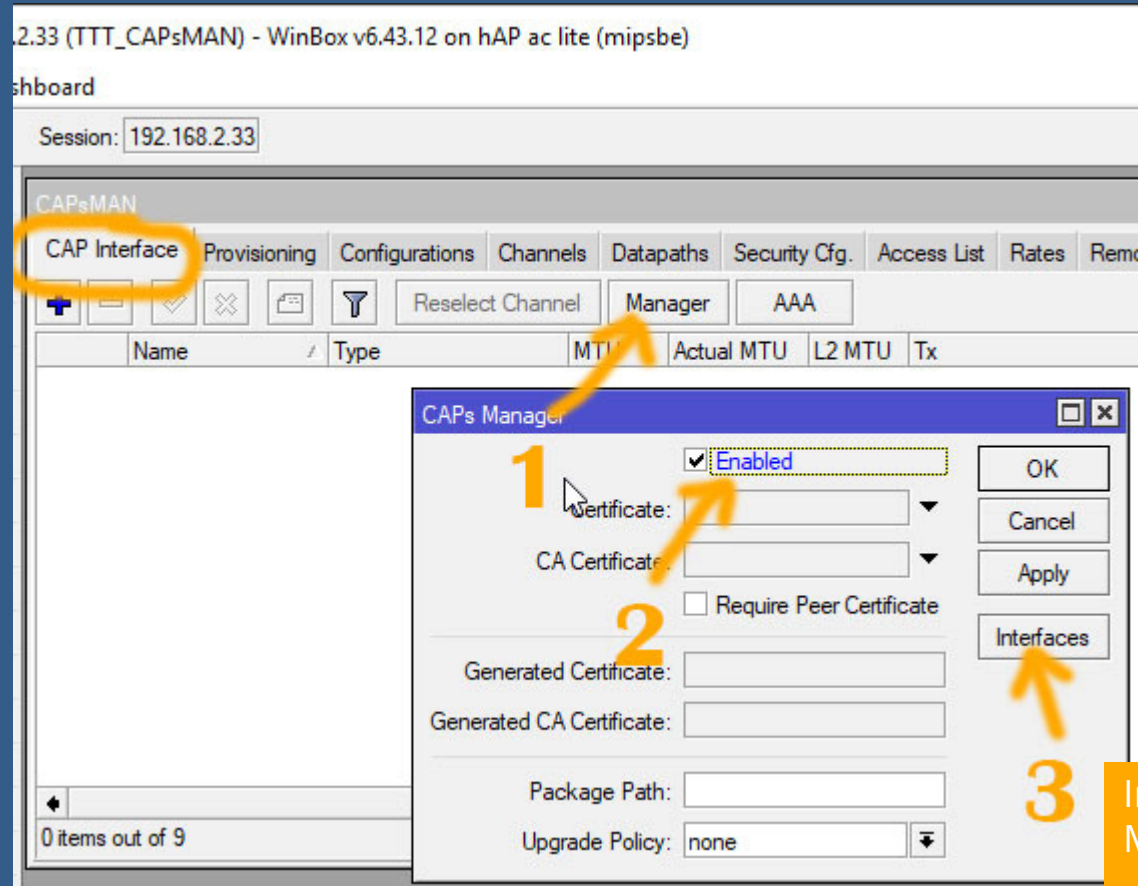


In Datapath, choose our datapath named: "datapath1".

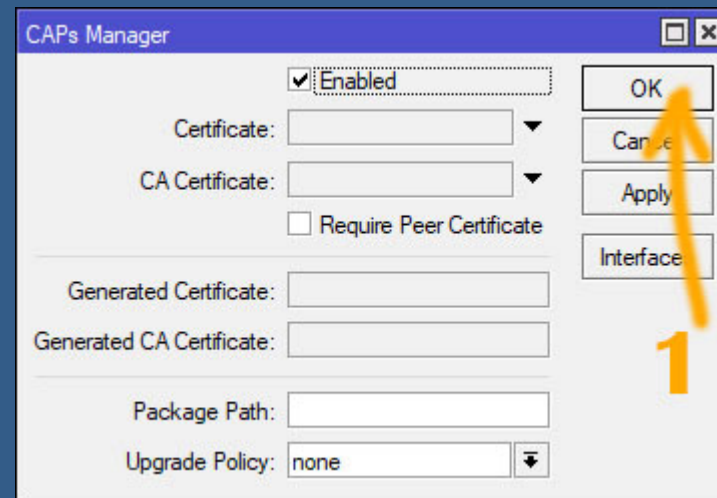
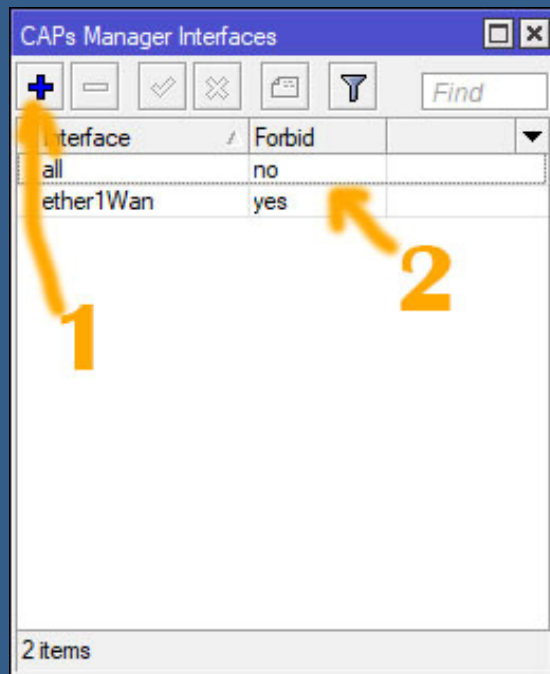
In Security, choose our security profile: security1



In Provisioning, we add a new CAPs Prov., Action: create enabled, Name Format: Identity.

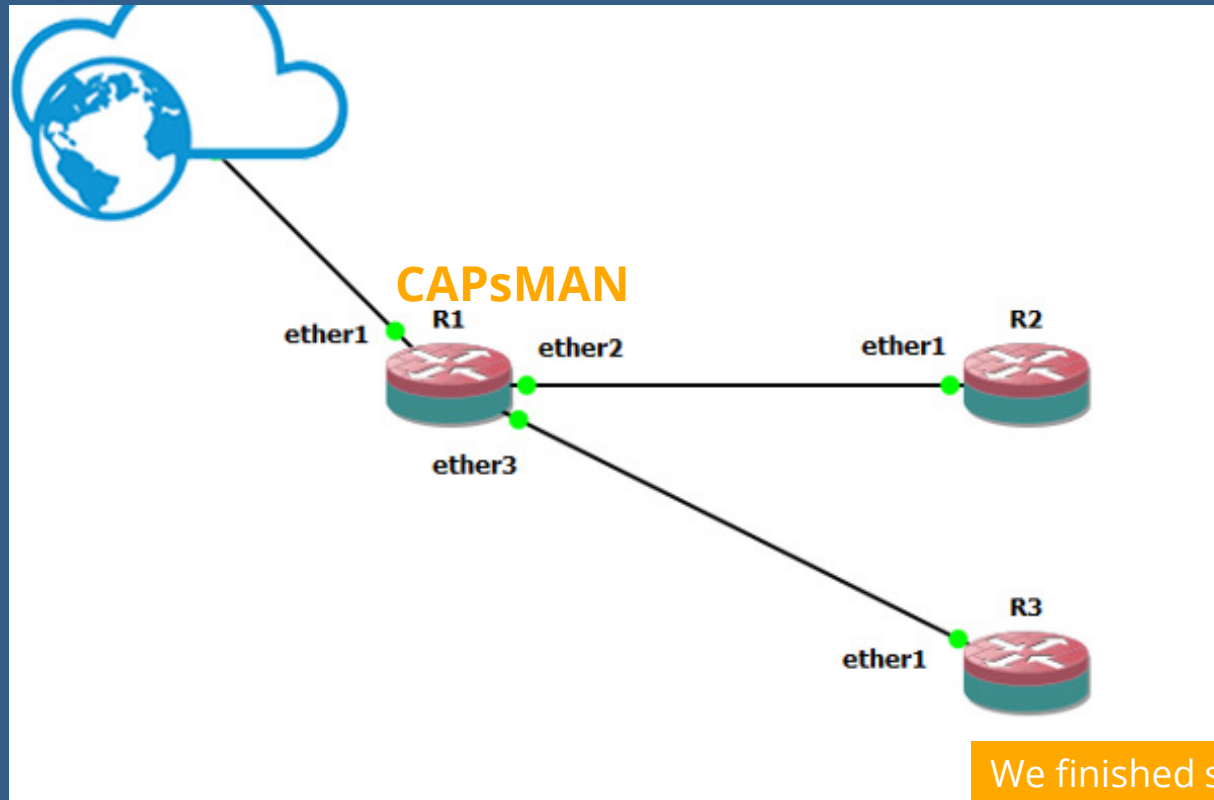


In CAP Interface, press:
Manager, Enable it.
Press Interfaces button



Add the interface where you have your internet connection: ether1Wan with forbid=yes

Last, press OK in CAPs Manager Window.



We finished setting-up CAPsMAN. Now let's setup the CAPs.

ensadmin@CC:2D:E0:28:5C:6F (TTT_CAPsMAN) - WinBox v6.43.12 on hAP ac lite (mipsbe)

Session Settings Dashboard

Safe Mode Session: CC:2D:E0:28:5C:6F

Quick Set CAPsMAN Interfaces Wireless Bridge PPP Switch Mesh IP MPLS OpenFlow Routing System Queues Files Log RADIUS

Wireless Tables

WiFi Interfaces W60G Station Nstreme Dual Access List Registration CAP WPS Client Setup Rep

Name	Type	Actual M
-- managed by CAPsMAN		
-- channel: 2442/20-Ce/gn(30dBm), SSID: YourSSID, CAPsMAN forwarding		
X wlan1	Wireless (Atheros AR9300)	
-- managed by CAPsMAN		
-- channel: 5785/20-eeCe/ac(30dBm), SSID: YourSSID, CAPsMAN forwarding		
X wlan2	Wireless (Atheros AR9888)	

2 items out of 13

CAP

☒ Enabled

Interfaces: wlan1 wlan2

Certificate: none

Discovery Interfaces: ether2

☐ Lock To CAPsMAN

CAPsMAN Addresses:

CAPsMAN Names:

CAPsMAN Certificate Common Names:

Bridge: none

☐ Static Virtual

Requested Certificate:

Locked CAPsMAN Comm

OK Cancel Apply

1 2 3 4

In R2, or all CAPs that we need to add to this CAPsMAN, we do the following in Interface -> Wireless -> CAP

CAPsMAN

CAP Interface

Provisioning

Configurations

Channels

Datapaths

Security Cfg.

Access List

Rates

Remote CAP

Radio

+

-

✓

✗

📄

🔍

Reselect Channel

Manager

AAA

	Name	Type	MTU	Actual MTU	L2 MTU	Tx	Rx
SMB	↔ R2-1	CAP Interface	1500	1500	1600		0 bps
RSMB	↔ R2-2	CAP Interface	1500	1500	1600		0 bps
SMB	↔ TTT_CAPsMAN-1	CAP Interface	1500	1500	1600		0 bps
SMB	↔ TTT_CAPsMAN-2	CAP Interface	1500	1500	1600		0 bps

⬅

4 items out of 13

Since our R1

4 items out of 13

Since our R1 router, has wireless interfaces of its own, we can also add them to the CAPsMAN. This is the final view of our setup.

CAPsMAN											
CAP Interface Provisioning Configurations Channels Datapaths Security Cfg. Access List Rates Remote CAP Radio Registration Table											
CAPs Scanner Find											
Interface	SSID	MAC Address	EAP Identity	Tx Rate	Rx Rate	Tx Signal	Rx Signal	Uptime	Tx/Rx Packets	Tx/Rx Bytes	
Wifi02-1	mulliri	C4:93:D9:2E:54:55		39Mbps-...	39Mbps-...	0	-75	06:29:47...	15 337/12 229	13.2 MiB/2050.5 ...	
Wifi02-1	mulliri	CC:73:14:3C:AF:D2		21.6Mbp...	1Mbps	0	-87	01:49:12...	68 425/46 651	80.2 MiB/5.6 MiB	
Wifi02-1	mulliri	88:83:22:38:DB:6A		57.7Mbp...	65Mbps-...	0	-68	00:49:34...	2 481/2 445	667.7 KiB/1147.3...	
Wifi02-1	mulliri	5C:51:81:B5:EC:09		52Mbps-...	58.5Mbp...	0	-66	00:44:06...	1 902/2 030	1499.3 KiB/279.6...	
Wifi02-1	mulliri	EC:10:7B:6F:7C:F2		52Mbps-...	26Mbps-...	0	-77	00:42:11...	366/357	102.7 KiB/50.8 KiB	
Wifi02-1	mulliri	24:18:1D:33:BA:BE		115.5Mb...	130Mbps...	0	-62	00:35:36...	15 253/10 830	18.7 MiB/1476.8 ...	
Wifi02-1	mulliri	04:D6:AA:B8:09:7F		130Mbps...	86.6Mbp...	0	-64	00:32:40...	131 492/27 702	169.5 MiB/2939.0...	
Wifi02-1	mulliri	28:3F:69:57:D5:5B		58.5Mbp...	13Mbps-...	0	-70	00:07:30...	2 443/2 313	2672.8 KiB/248.6...	
Wifi02-1	mulliri	0C:D7:46:8B:92:34		58.5Mbp...	39Mbps-...	0	-82	00:03:06...	3 651/3 175	4161.3 KiB/383.3...	
Wifi02-1	mulliri	04:B1:67:1E:97:CA		1Mbps	1Mbps	0	-81	00:00:25...	9/11	1994 B/1522 B	
10 items											

Monitor client connections in Registration Table.


```
/interface bridge add name=bridgeCAPS
/ip address add interface=bridgeCAPS address=192.168.8.1/24
/caps-man datapath
add bridge=bridgeCAPS client-to-client-forwarding=no local-forwarding=no
name=datapath1
/caps-man security
add authentication-types=wpa-psk,wpa2-psk encryption=aes-ccm name=security1
passphrase=\
    mikrotikriga
/caps-man configuration
add datapath=datapath1 mode=ap name=cfg1 security=security1 ssid=YourSSID
/caps-man manager
set enabled=yes
/caps-man provisioning
add action=create-enabled master-configuration=cfg1 name-format=identity
```

```
/interface wireless cap set discovery-interfaces=ether1 interfaces=wlan1,wlan2  
enabled=yes
```



VS



Any difference?

Extensive setups

Frequency tuning

Use only non-overlapping

Permit only g/n

Limit data-rates

VLANs

Use of VLANs in these networks, gives the possibility to create smaller and isolated networks for different purposes

Virtual SSID

Offer multiple SSID in the same APs, giving possibility to have different networks in the same physical setup

Access Control

Play with access control options, to have as much control as possible over the clients connecting, based on signal, mac, etc



CAPsMAN

Provisioning Configurations Channels Datapaths Security Cfg. Access List Rates Remote CAP Radio Registration Table ...

+ - [Icons] Find

Name	Frequency	Control Channel ...	Band
channel1	2412		2ghz-g/n
channel6	2437		2ghz-g/n
channel11	2462		2ghz-g/n

3 items

CAPs Channel <channel1>

Name: channel1 OK

Frequency: 2412 Cancel

Control Channel Width: Apply

Band: 2ghz-g/n Comment

Extension Channel: Copy

Tx Power: Remove

Save Selected:

Reselect Interval:

Skip DFS Channels:

Create manually the channels 1,6,11 for 2.4GHZ and put also the band to 2ghz-g/n to not use the old nasty 2ghz-b. Input the channels manually for each interface.

CAPsMAN									
Provisioning Configurations Channels Datapaths Security Cfg. Access List Rates Remote CAP Radio Registration Table ... + - ✓ ✗ 📄 🔍 Find									
#	MAC Address	MAC Mask	Interface	Signal Range	Action	Client To Clie...	VLAN Mo...	VLAN ID	▼
0	↕		all	-80..120	accept				
1	↕		all	-120..-81	reject				

```

/caps-man access-list
add action=accept allow-signal-out-of-range=10s disabled=no interface=any \
  signal-range=-80..120 ssid-regexp=""
add action=reject allow-signal-out-of-range=10s disabled=no interface=any \
  signal-range=-120..-81 ssid-regexp=""

```

Make roaming as easy as possible.

CAPsMAN

CAP Interface Provisioning Configurations Channels Datapaths Security Cfg. Access List Rates Remote CAP Radio ...

#	Radio MAC	Identity Regexp	Common Nam...	Action	Master Configurati...	Slave Configuration
0	00:00:00:00:00:00			create en...	cfg1	cfg2GuestStaff, cfg3Finance

1 item (1 selected)

CAPs Provisioning <00:00:00:00:00:00>

Radio MAC: 00:00:00:00:00:00

Hw. Supported Modes:

Identity Regexp:

Common Name Regexp:

IP Address Ranges:

Action: create enabled

Master Configuration: cfg1

Slave Configuration: cfg2GuestStaff

 cfg3Finance

Name Format: identity

Name Prefix:

Set slave configurations so each interface in CAPsMAN will have automatically added virtual interfaces for different purposes

CAPsMAN								
CAP Interface Provisioning Configurations Channels Datapaths Security Cfg. Access List Rates Remote CAP Radio ...								
+ - ✓ ✗ [Icon] [Icon] Reselect Channel Manager AAA Find								
	Name	Type	MTU	Actual MTU	L2 MTU	Tx	Rx	
SMB	↔ R2-1	CAP Interface	1500	1500	1600		0 bps	
SB	↔ R2-1-1	CAP Interface	1500	1500	1600		0 bps	
SB	↔ R2-1-2	CAP Interface	1500	1500	1600		0 bps	
SMB	↔ R2-2	CAP Interface	1500	1500	1600		0 bps	
SB	↔ R2-2-1	CAP Interface	1500	1500	1600		0 bps	
RSB	↔ R2-2-2	CAP Interface	1500	1500	1600		0 bps	
SMB	↔ TTT_CAPsMAN-1	CAP Interface	1500	1500	1600		0 bps	
SB	↔ TTT_CAPsMAN-1-1	CAP Interface	1500	1500	1600		0 bps	
SB	↔ TTT_CAPsMAN-1-2	CAP Interface	1500	1500	1600		0 bps	
SMB	↔ TTT_CAPsMAN-2	CAP Interface	1500	1500	1600		0 bps	
SB	↔ TTT_CAPsMAN-2-1	CAP Interface	1500	1500	1600		0 bps	
SB	↔ TTT_CAPsMAN-2-2	CAP Interface	1500	1500	1600		0 bps	
12 items out of 25								

Set slave configurations so each interface in CAPsMAN will have automatically added virtual interfaces for different purposes

Multiroom Resort Setup

- 123 x wsAP ac Lite
- 10 x wAP ac
- 10 x cAP Ac
- 6 x CRS328-24P-4S+RM
- 1 x CCR1009-7G-1C



Conclusion

After we setup **CAPsMAN**, we have:

- Much more control over the Wifi Network
- Easier expansion
- More stable client connections
- A nearly unlimited number of options on configurations of such networks
- **Happy Clients**
- **Paid Invoices** 🥰

Thank you for your attention!

Questions?

Drop an e-mail at erioni@gmail.com and/or
follow **Mikrotik.Albania** in Instagram

