MikroTik

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UNIVERSITAS ADVENT INDONESIA

Bandwidth Management for University Campus Network

presented by Andrew F. Pakpahan

Self Introduction - *Andrew Pakpahan*

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Study Case

UNIVERSITAS ADVENT INDONESIA

- Located at Parongpong, Bandung, West Java, Indonesia
- UNAI is a small private boarding University where most of the students stayed in the dormitory and the teachers live in University's provided housing inside the campus.
- The university provide 24 hours internet service for the teachers and students on 25ha campus area.

Our Facts

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- We are using various kind of Mikrotik Devices since 2007: RB1000, RB1100 series RB1200, RB2011 series, RB450G, RB750 series, Cloud Core Router
- Currently we have 50mbps dedicated internet (international) connection. We don’t have separate connections between IIX (Indonesia’s Internet) and International Internet.
- We have around 1800 students, 1200 of them stays in the dormitories.
- We have 80+ Wireless APs, hundreds cable ports, and miles of copper and fibre cables around the campus.
- The system recognised over 2000+ unique MAC addresses had connected to the network on one semester.
- In the peak time we have around 500 concurrent users connected to the network.

Classic Facts

- Bandwidth is limited.
- User's bandwidth demands is always increasing.
- Only 20% of the users takes 80% all the bandwidth. (20% heavy users)
- Doesn't matter how much bandwidth we throw to the users, they will eat it up!

Bandwidth Management

Bandwidth Management - *What we had tried*

- Linux Based, Squid Pools/HTB scripts queueing.
- Hotspot, Per User Simple Queue.
- Queue Tree + PCQ.
- Prioritising then use PCQ queue (can't be done in Router OS v6.x)

Is it enough?

What's missing?

What's missing?

- With PCQ we can share the bandwidth "**equally**" to all connected users.

- We **can't identify** those heavy users using the existing bandwidth management techniques.

We need to do better bandwidth management!

What we wanted?

- We want to **prioritise users** with less daily usage than those with heavy usage.

- We want users with less internet usage get faster speed than those whose using it a lot.

- User who always want to download something from internet, should be **punished** (we want them to get **slower** speed).

The Strategy

Identify those 'heavy users' and put them in certain group/pool with limited speed.

How we did it?

- Using User based Authentication System (hotspot, PPPoE, etc) with external radius server, custom perl script and Mikrotik's radius attributes.
- Record each client bandwidth usage with the radius server accounting system.
- Create a script running on the server to calculate user's total bandwidth of the day.
  - Then the script will send a radius attributes to Mikrotik to assigns users in different HTB pools according to their usage
  - Run the script every certain time interval (every minutes or every five minutes)
- Create a script that will reset the counters and groups at certain time (we set it at midnight)

How we did it? - continue

- Identify the users:
  - A: Users that newly connected to the network and use less than X MB of bandwidth.
  - B: Users that already using Y MB of bandwidth.
  - C: Users that already using Z MB of bandwidth.
  - Where (Z > Y > X)
- Put the users in certain pools (Using address list features on Mikrotik)
  - Put the A users in group0
  - Put the B users in group1
  - Put the C users in group2
- Put the bandwidth limitations on pools and users.
- The Queue Tree used for bandwidth allocation for each pool.
- The PCQ used for bandwidth allocation for each users on each pool.

Bandwidth Management Design - Per User

Group	BW Usage	Rate	Burst
group0	less than 200MB	1 Mbps	2 Mbps
group1	200MB - 400MB	384 Kbps	512 Kbps
group2	400MB - 600MB	256 Kbps	384 Kbps
group3	more than 600MB	64 Kbps	128 Kbps

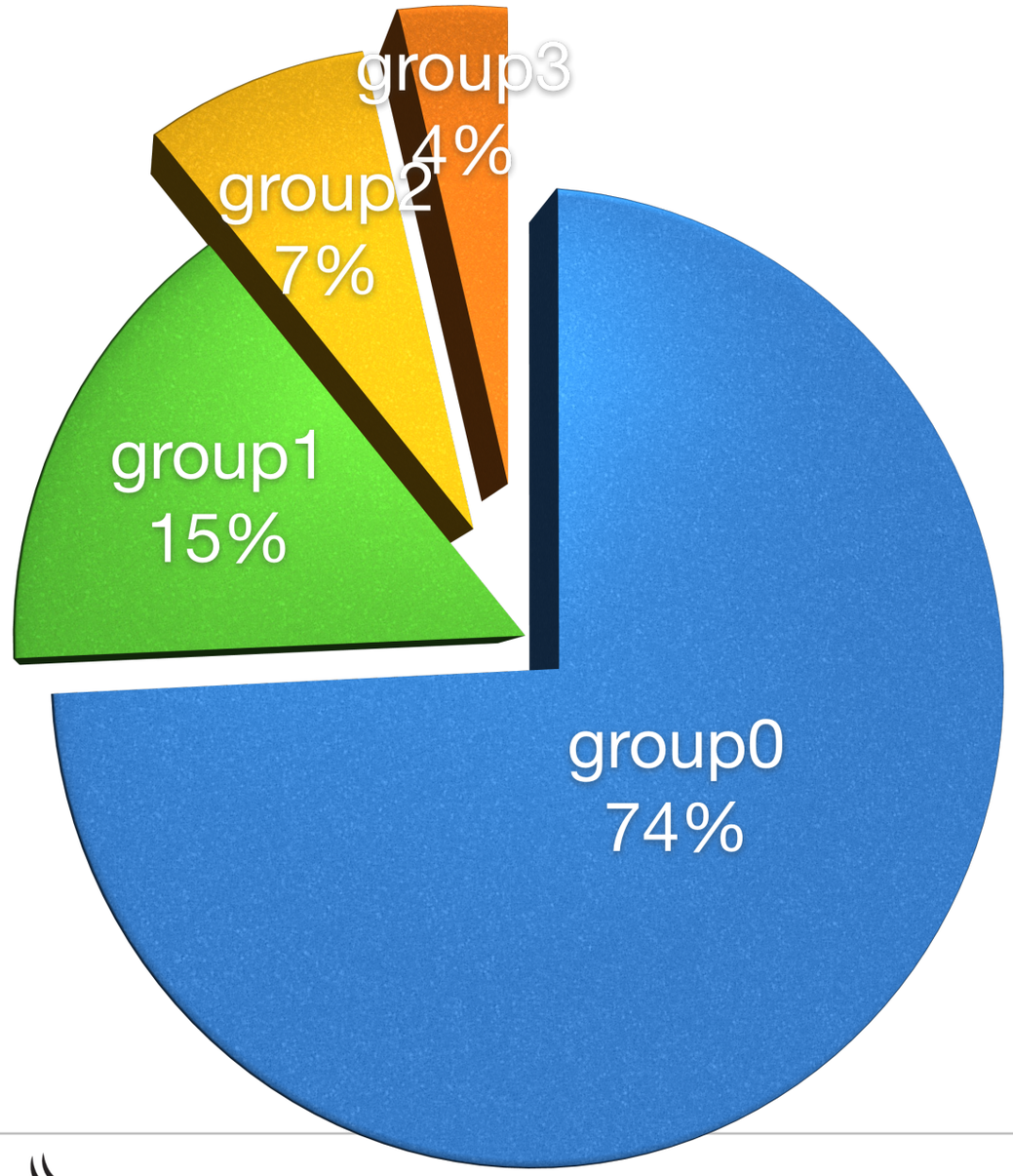
Bandwidth Management Design in Graph

Bandwidth Management Design - Pools

Group	BW Usage	Limit at	Max Limit
group0	less than 200MB	10 Mbps	40 Mbps
group1	200MB - 400MB	4 Mbps	8 Mbps
group2	400MB - 600MB	2 Mbps	4 Mbps
group3	more than 600MB	512 Kbps	1 Mbps

Bandwidth Management Design in Graph

Bandwidth allocation for each group/pool



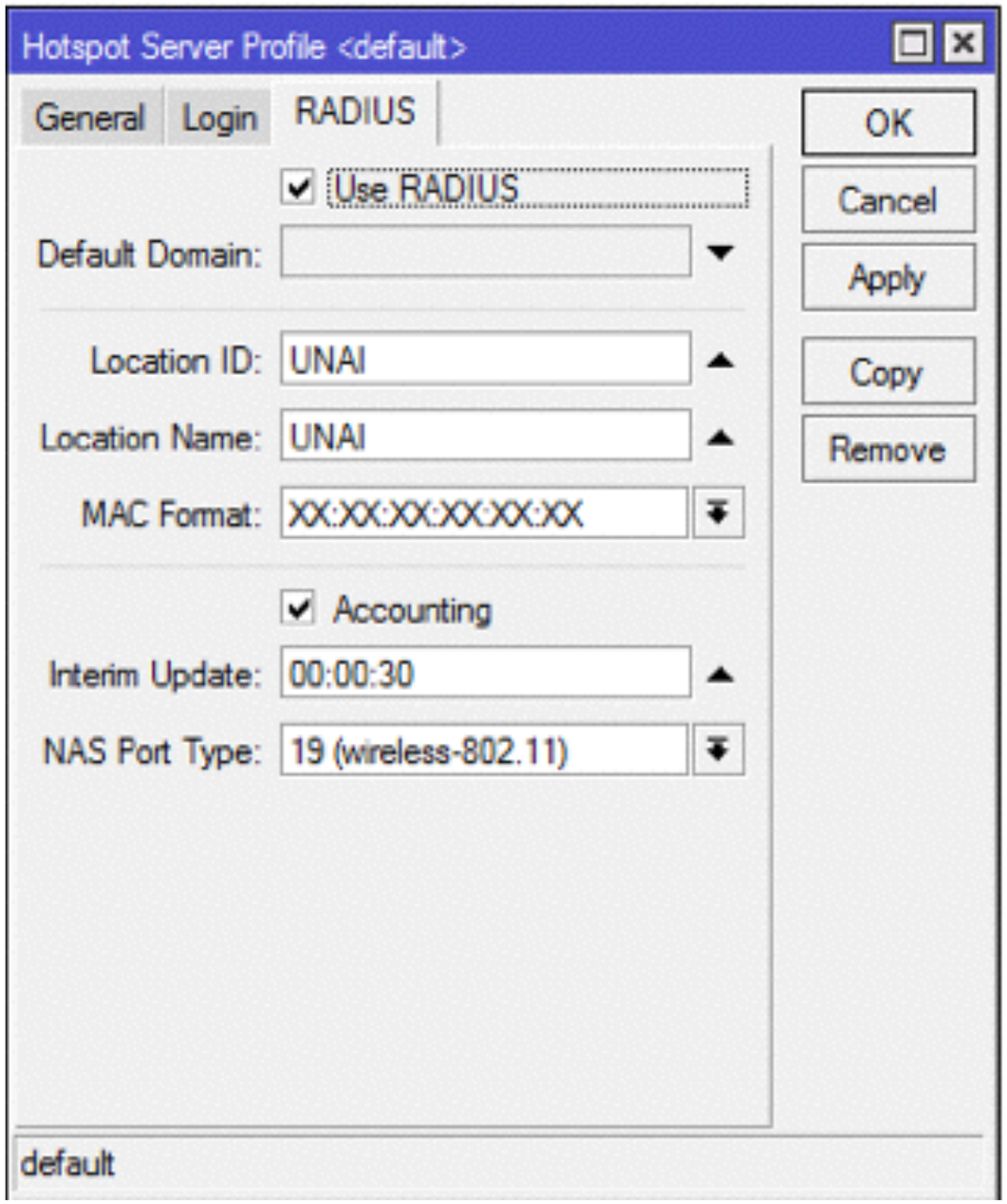
- Group0 got much large bandwidth than the other groups.
- Group3 got the less bandwidth.

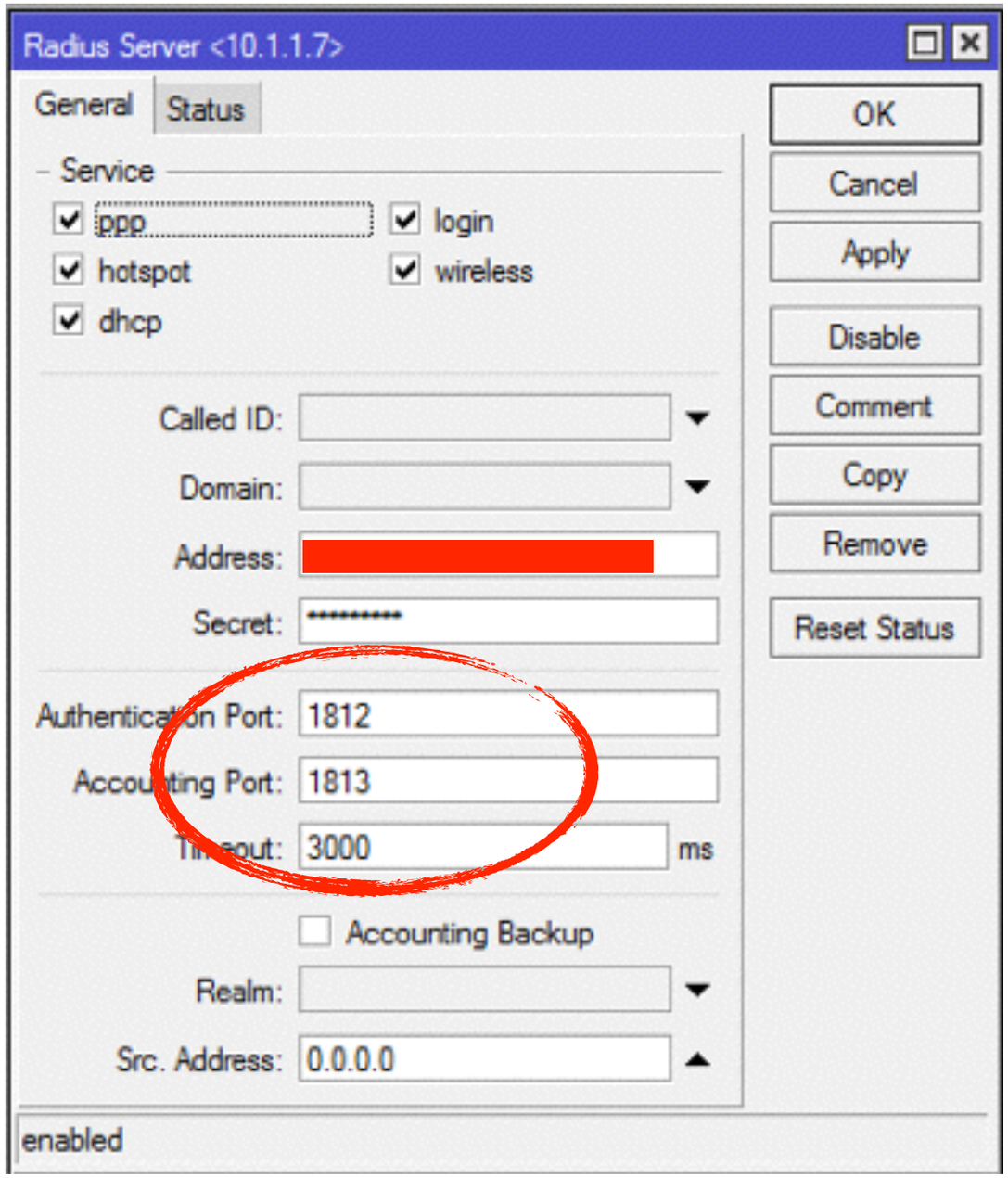
What you need to know before trying this setup

Installing Freeradius + Daloradius for Mikrotik

http://andrewpakpahan.blogspot.com/2012/08/installing-and-configuring-freeradius.html

Setting up Hotspot Server & Radius





The bandwidth management script

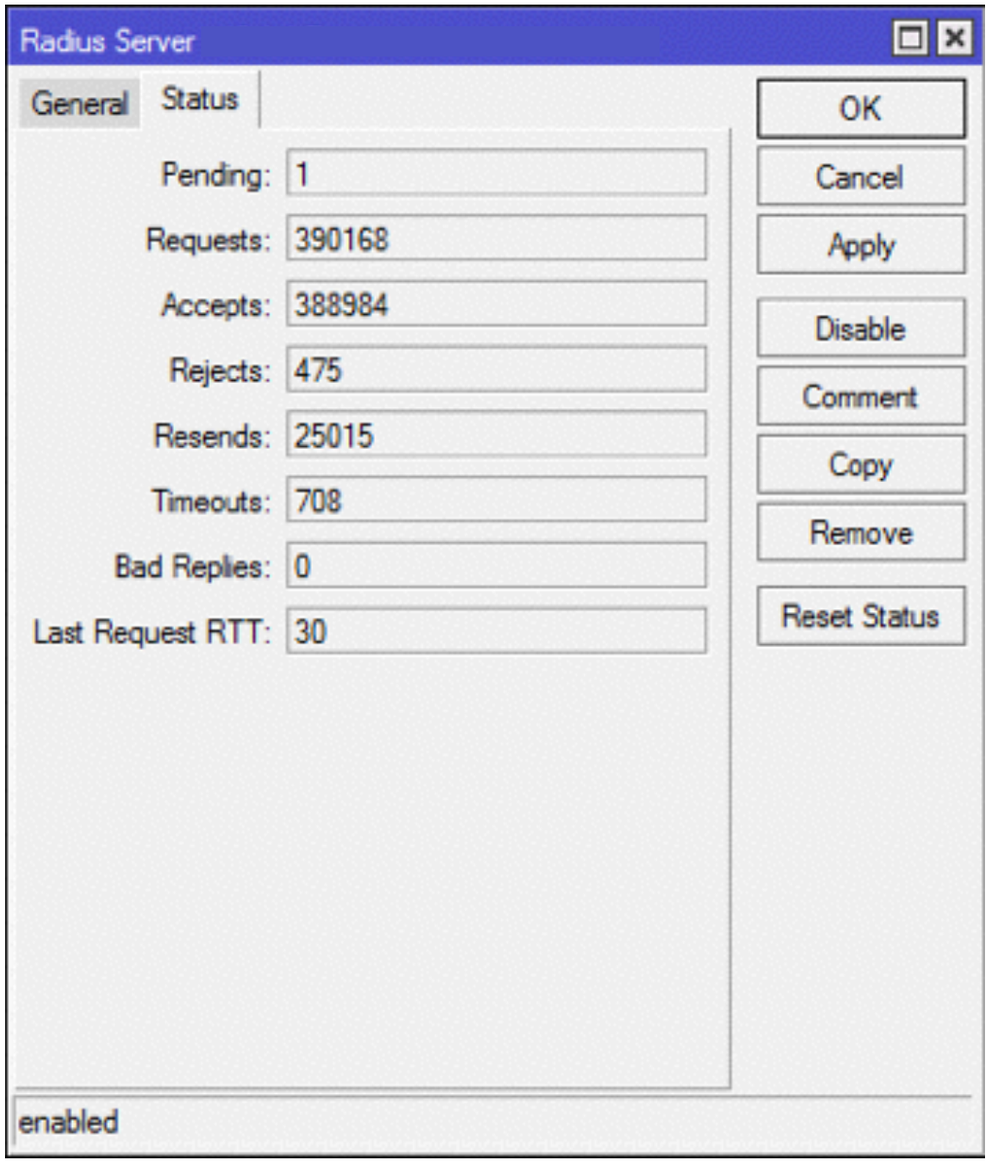
- You can user PHP/Perl or other programming languages.
- In our case we use Perl.
- What the script do?
  - Calculate users usage.
  - Put the users in different group.
  - Send users groups radius updates to Mikrotik.

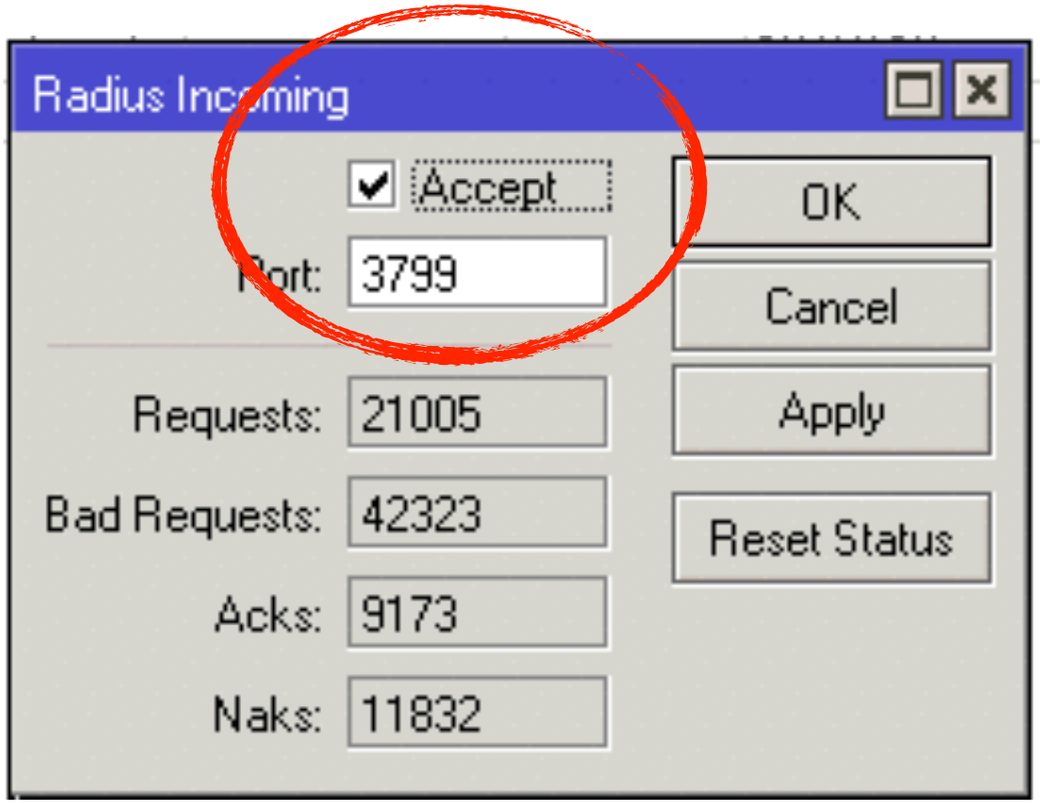
Radius attribute sends to Hotspot Server

How we send Radius attribute to the router using a perl script

```
system ("echo \”User-Name=[username],Framed-IP-
Address=[routeripaddress],Acct-Session-
Id=[acctsessionid],NAS-
Identifier=[nas_identifier],Mikrotik-
Group=[group]\” | radclient -x [router_ip]:3799
coa [password]”);
```

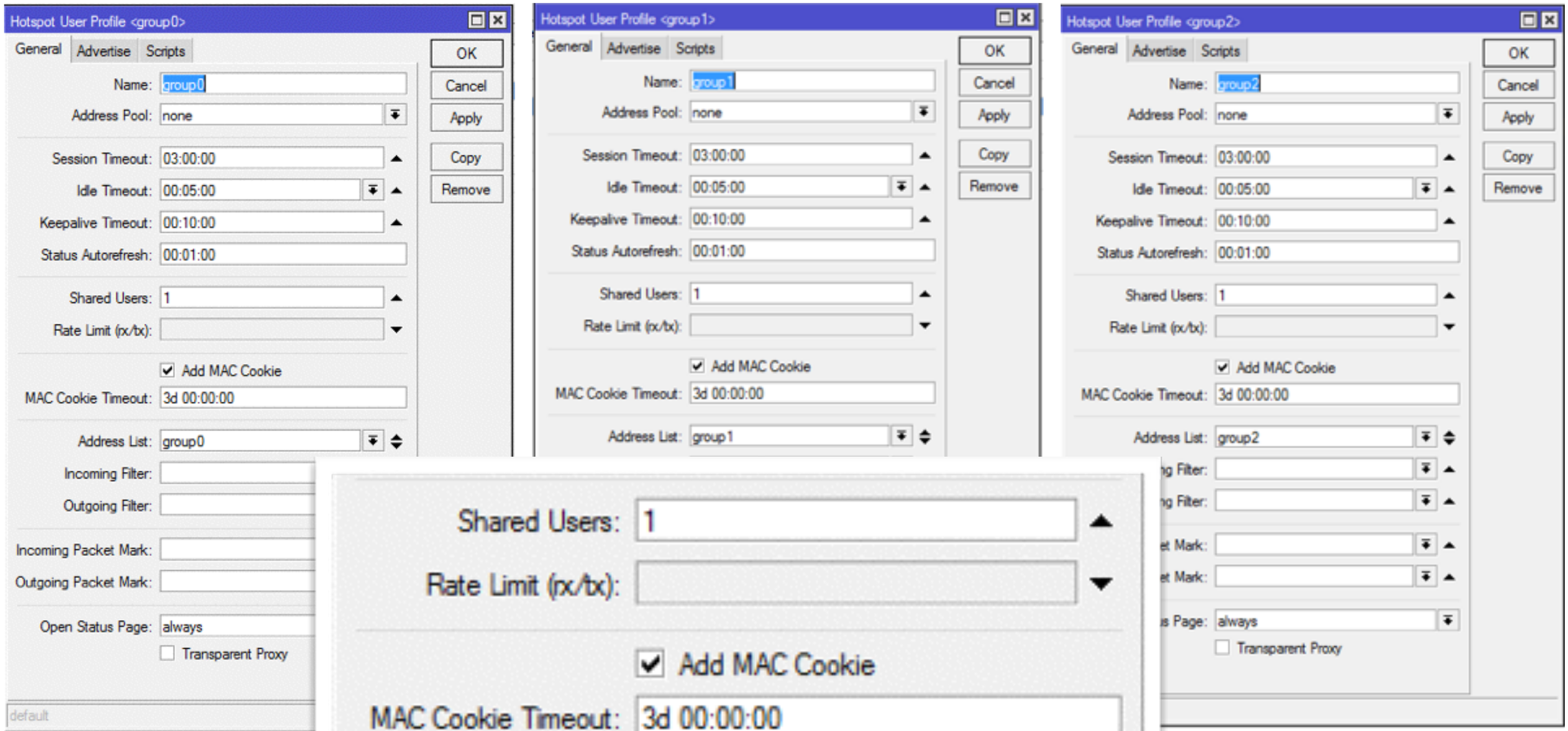
Radius Status on Hotspot Server





Don’t forget to accept incoming radius

Hotspot User Profile Setting



Firewall Mangle

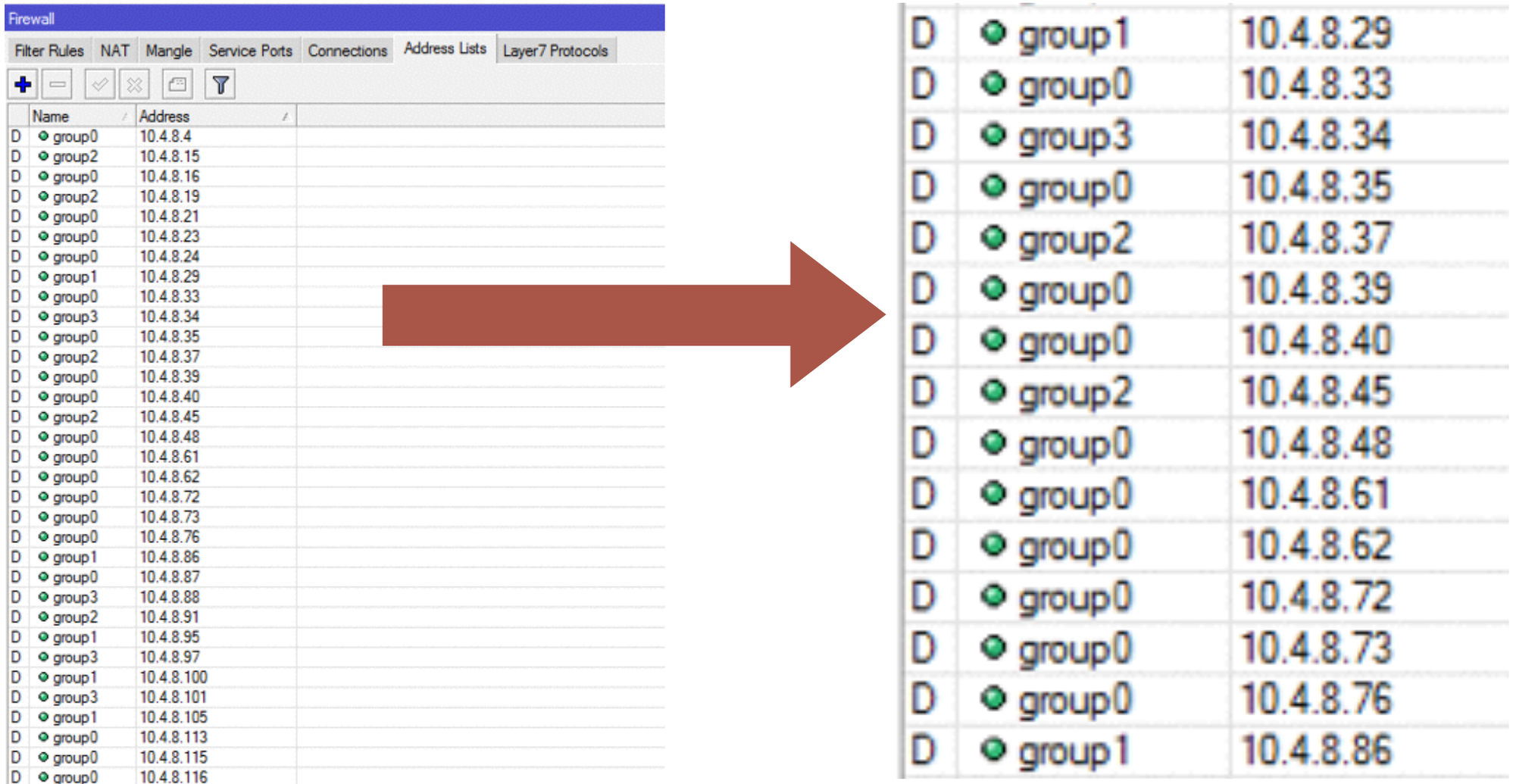
;;; Group0												
0		mar...	forward						ether3		121.7 GiB	110 368 ...
1		mar...	forward							group0_conn_download	121.7 GiB	110 555 ...
2		mar...	forward						ether2		10.2 GiB	80 949 918
3		mar...	forward							group0_conn_upload	10.2 GiB	80 279 868
;;; Group1												
4		mar...	forward						ether3		17.6 GiB	16 587 920
5		mar...	forward							group1_conn_download	17.6 GiB	16 649 087
6		mar...	forward						ether2		1686.9 MiB	12 769 935
7		mar...	forward							group1_conn_upload	1680.4 MiB	12 647 185
;;; Group2												
8		mar...	forward						ether3		10.6 GiB	10 074 953
9		mar...	forward							group2_conn_download	10.6 GiB	10 106 359
10		mar...	forward						ether2		1198.8 MiB	7 904 763
11		mar...	forward							group2_conn_upload	1194.1 MiB	7 823 563
;;; Group3												
12		mar...	forward						ether3		922.1 MiB	1 057 682
13		mar...	forward							group3_conn_download	922.8 MiB	1 063 966
14		mar...	forward						ether2		131.5 MiB	912 533
15		mar...	forward							group3_conn_upload	128.6 MiB	873 236

We need to do mangle for all our defined groups

Firewall Mangle script

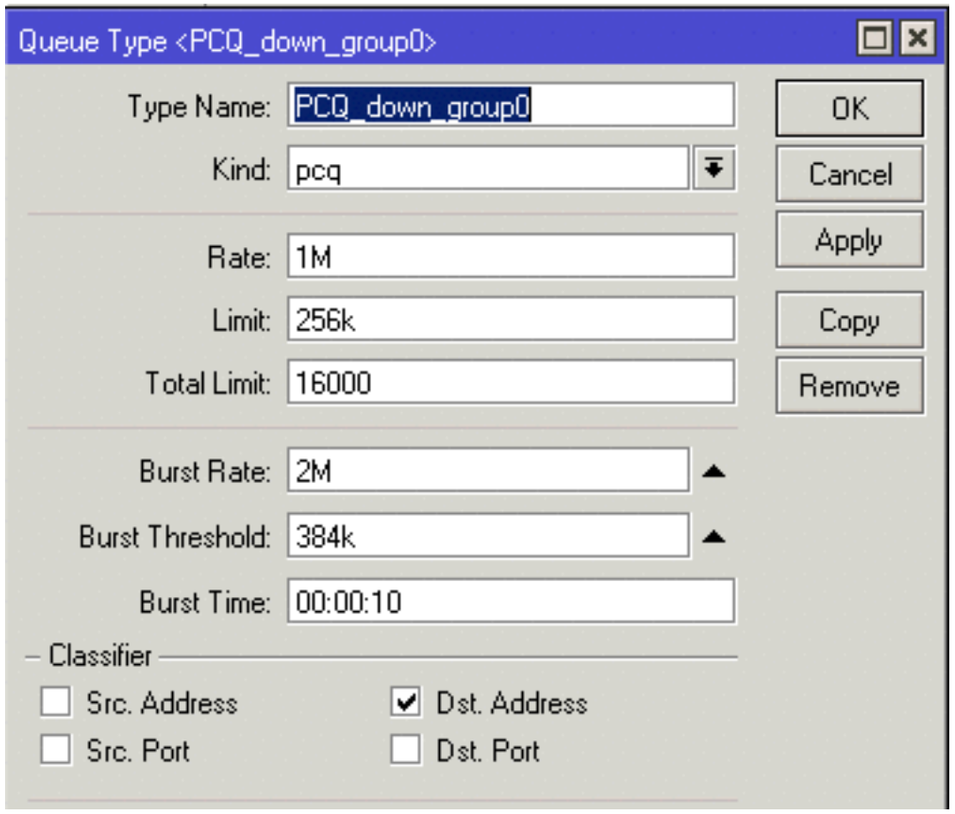
```
/ip firewall mangle
add action=mark-connection chain=forward comment=Group0 dst-address-list=\
    group0 in-interface=ether3 new-connection-mark=group0_conn_download \
    src-address-list=!localnet
add action=mark-packet chain=forward connection-mark=group0_conn_download \
    new-packet-mark=group0_packet_download passthrough=no
add action=mark-connection chain=forward dst-address-list=!localnet \
    in-interface=ether2 new-connection-mark=group0_conn_upload \
    src-address-list=group0
add action=mark-packet chain=forward connection-mark=group0_conn_upload \
    new-packet-mark=group0_packet_upload passthrough=no
add action=mark-connection chain=forward comment=Group1 dst-address-list=\
    group1 in-interface=ether3 new-connection-mark=group1_conn_download \
    src-address-list=!localnet
```

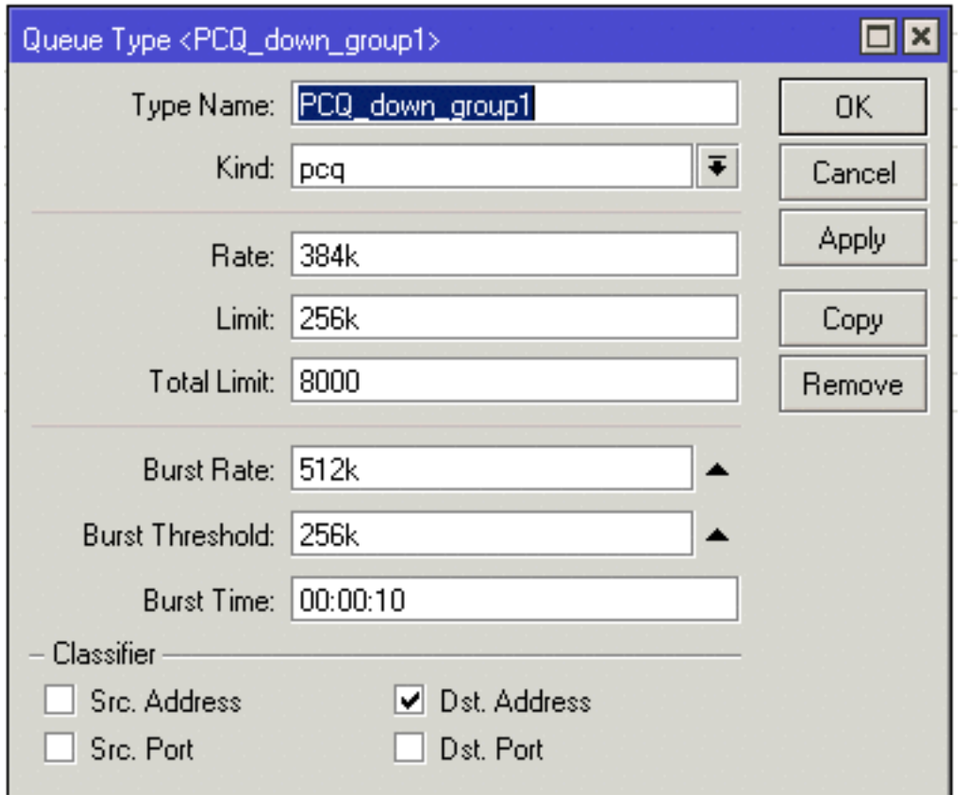
Firewall Address List



Users divided to different groups

PCQ Queue Setting





We must create different PCQ Queue type for each group

The Queue Tree

Total_download	ether2			40M	34.4 Mbps	0 B	152.8 GiB	138 26...	0		
group0_download	Total_downlo...	group0...	10M	40M	22.9 Mbps	346.6 KiB	123.3 GiB	110 48...	35 374	153	
group1_download	Total_downlo...	group1...	4M	8M	7.1 Mbps	463.1 KiB	17.9 GiB	16 625 ...	14 556	55	
group2_download	Total_downlo...	group2...	2M	4M	3.3 Mbps	670.1 KiB	10.8 GiB	10 101 ...	0	27	
group3_download	Total_downlo...	group3...	512k	1M	574.1 kbps	565.0 KiB	942.0 MiB	1 063 5...	0	14	
Total_upload	ether3			15M	44.1 kbps	0 B	14.4 GiB	101 13...	0		
group0_upload	Total_upload	group0...			27.5 kbps	0 B	11.2 GiB	79 869 ...	11 829	78	
group1_upload	Total_upload	group1...			8.9 kbps	0 B	1844.3 MiB	12 597 ...	1 189	33	
group2_upload	Total_upload	group2...			6.2 kbps	0 B	1295.9 MiB	7 802 7...	921	12	
group3_upload	Total_upload	group3...			1384 bps	0 B	140.0 MiB	869 757	25	5	

Total_download	
group0_download	153
group1_download	55
group2_download	27
group3_download	14
Total_upload	
group0_upload	78
group1_upload	33
group2_upload	12
group3_upload	5

Users are divided to different pool according to their group

Results

- We can **identify users** based on their bandwidth usage.
- Newly connected user will get 'standard' speed and placed in the first group0, after passing a certain limit (usage), the users will be placed in group1 and afterward.
- We can put **users in different group** according to their **internet usage**.
- Those 'heavy users' we targeted will get **slower speed** when they’re using the internet connection.

Thank You MikroTik

Thank you all for listening