Using MikroTik in Docsis Provisioning

Case study showing how to use a MikroTik router to provision cable modems

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Certifications

Overview

In this case study I'll demonstrate how I used a MikroTik router as a provisioning server for cable modems.

ISSUES TO OVERCOME

I needed to be able to deploy high speed internet to a number of apartments over an existing coax cable network.

Total end users would not exceed 200 per location

Rewiring the infrastructure with fiber and copper Ethernet was cost-prohibitive.

Client had an existing coax network which he used to provide local broadcast TV

Cost was a major factor

SOLUTION

Client added a low cost CMTS (Cable Modem Termination System) with necessary amplifiers to update coax system

MikroTik CCR router added as edge router

CCR configured to replace the need for additional modem provisioning servers


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Google Earth
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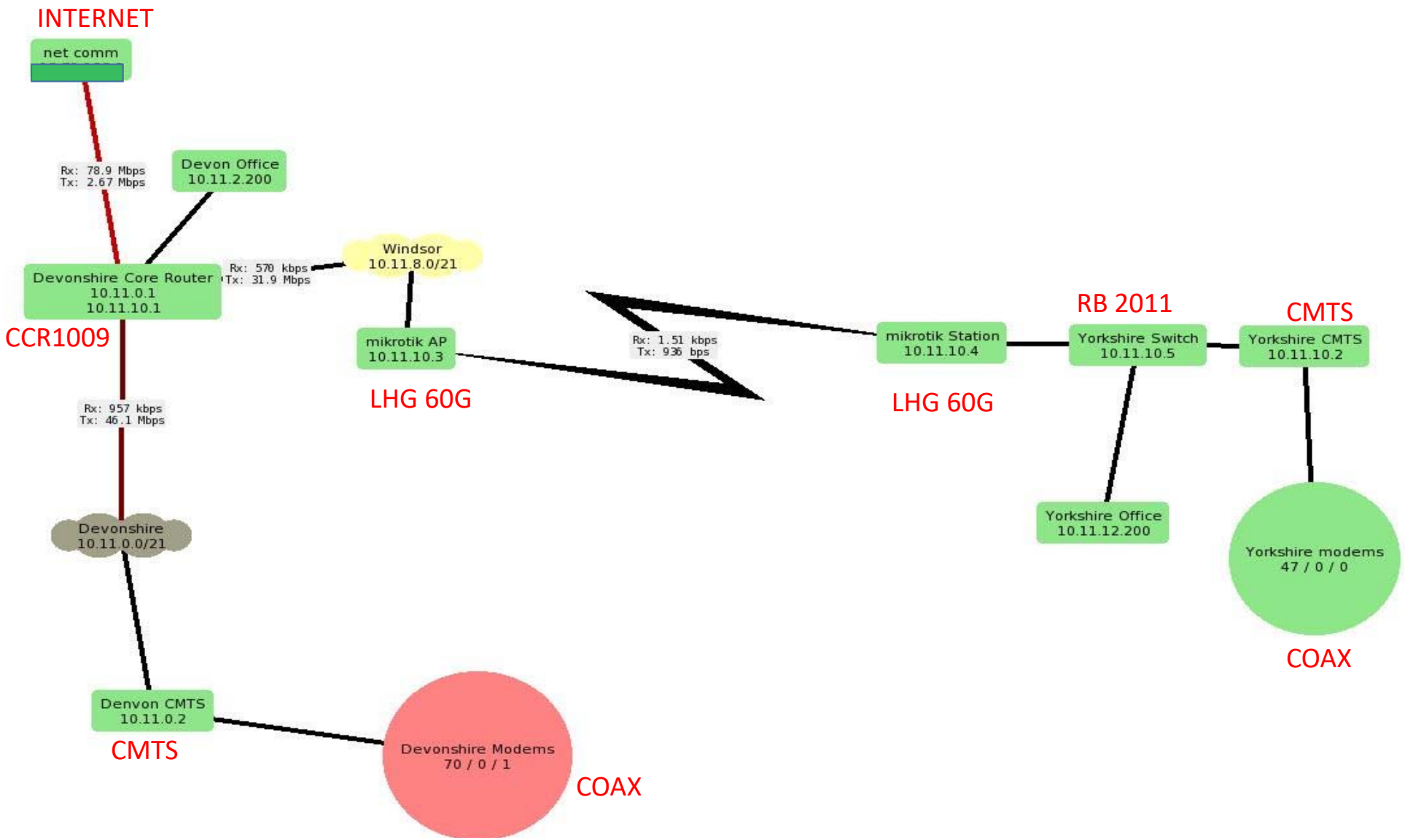

INTERNET
net comm
Rx: 78.9 Mbps
Tx: 2.67 Mbps
Devon Office
10.11.2.200
Devonshire Core Router
10.11.0.1
10.11.10.1
CCR1009
Rx: 570 kbps
Tx: 31.9 Mbps
Windsor
10.11.8.0/21
mikrotik AP
10.11.10.3
LHG 60G
Rx: 1.51 kbps
Tx: 936 bps
mikrotik Station
10.11.10.4
LHG 60G
RB 2011
Yorkshire Switch
10.11.10.5
CMTS
Yorkshire CMTS
10.11.10.2
Yorkshire Office
10.11.12.200
Yorkshire modems
47 / 0 / 0
COAX
Rx: 957 kbps
Tx: 46.1 Mbps
Devonshire
10.11.0.0/21
Denvon CMTS
10.11.0.2
CMTS
Devonshire Modems
70 / 0 / 1
COAX

CABLE MODEM OPERATION

Four Steps

1. Downstream Channel Search and Lock
   Basically layer one establishment over the RF on coax cable

2. DHCP
   IP address/mask /gateway
3. TOD (Time of Day)
4. TFTP
   Config File Download

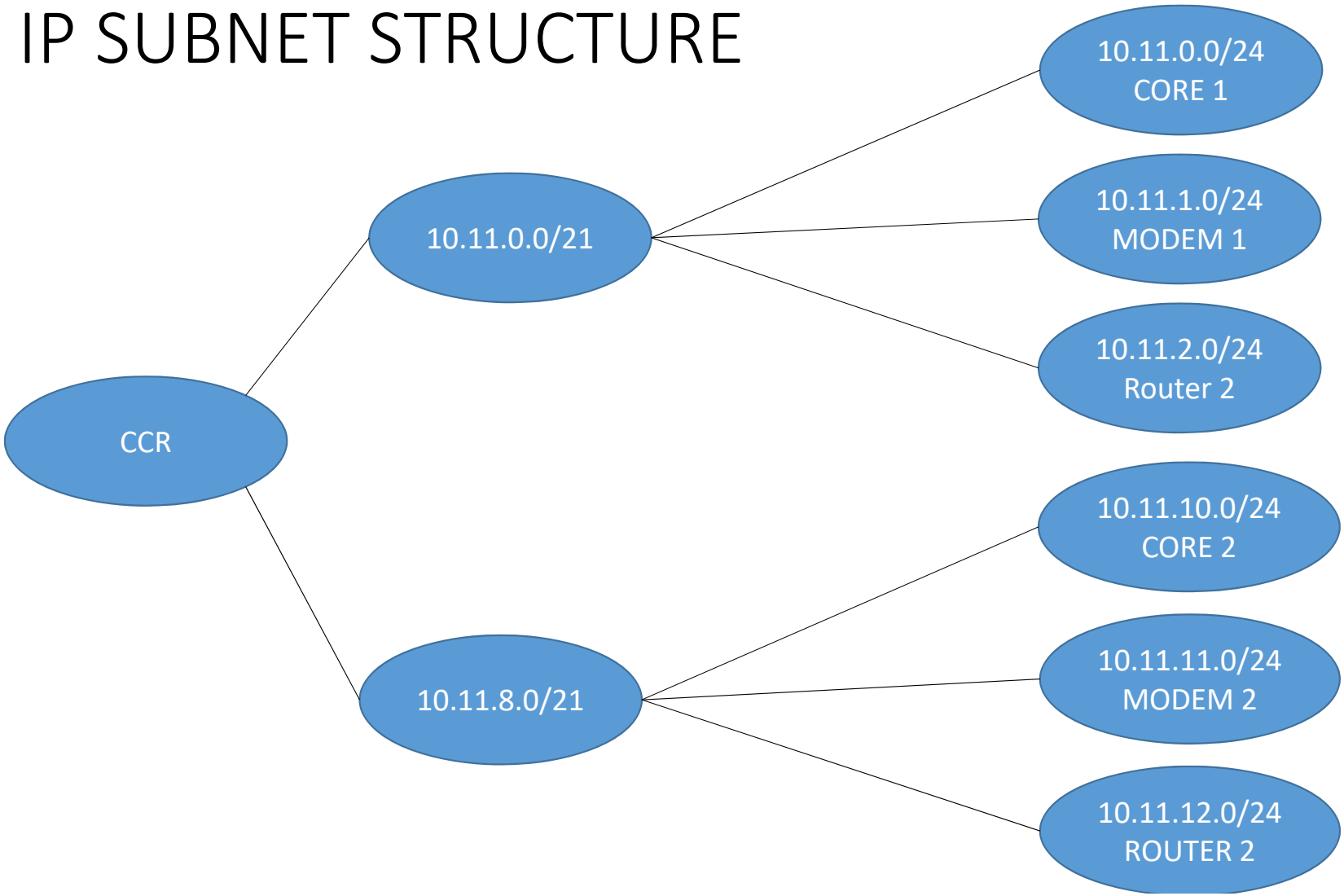
Client Router Operation

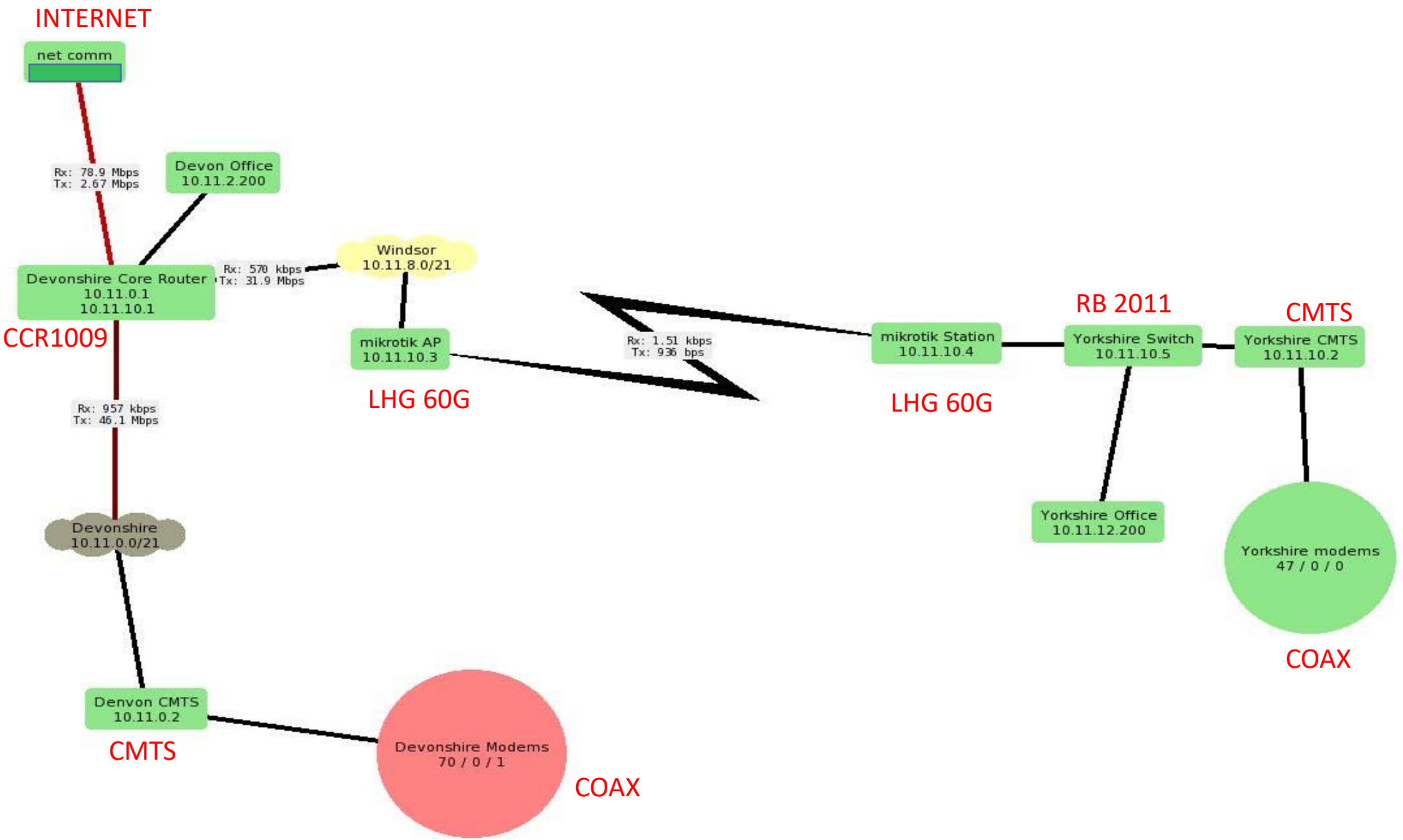
Most “modems” are actually a combination of cable modem and client wifi router

Once Modem “side” is online and operational the router “side” must be given its configuration

We accomplish this with a second ‘DHCP server’ to give out normal IP address, gateway, mask, and DNS server

IP SUBNET STRUCTURE

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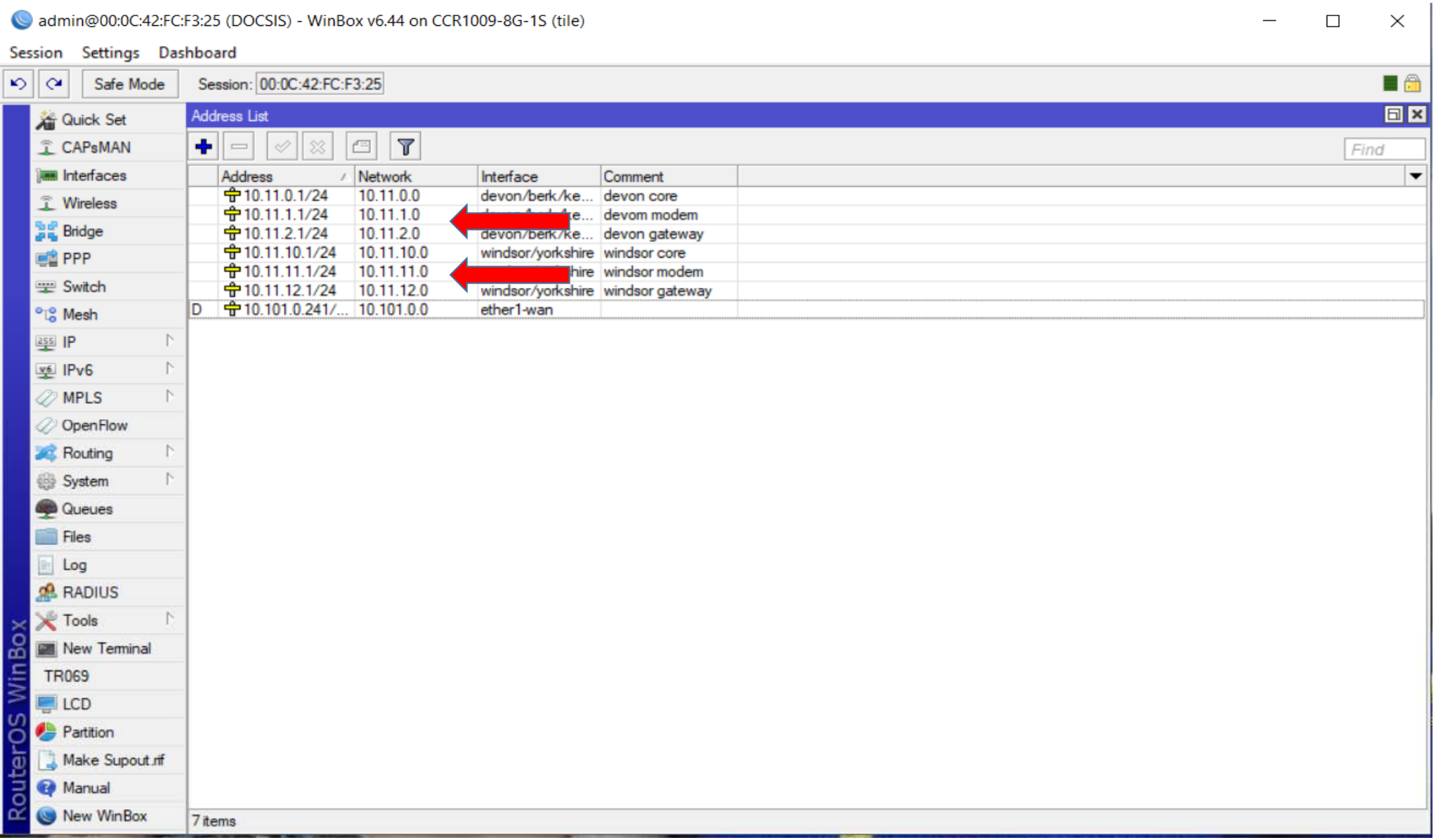

admin@00:0C:42:FC:F3:25 (DOCSIS) - WinBox v6.44 on CCR1009-8G-1S (tile)
Session Settings Dashboard
Safe Mode
Session: 00:0C:42:FC:F3:25
Quick Set
CAPsMAN
Interfaces
Wireless
Bridge
PPP
Switch
Mesh
IP
IPv6
MPLS
OpenFlow
Routing
System
Queues
Files
Log
RADIUS
Tools
New Terminal
TR069
LCD
Partition
Make Supout.rif
Manual
New WinBox
RouterOS WinBox
Address List
Find
Address
Network
Interface
Comment
10.11.0.1/24 10.11.0.0 devon/berk/ke... devon core
10.11.1.1/24 10.11.1.0 devom modem
10.11.2.1/24 10.11.2.0 devon/berk/ke... devon gateway
10.11.10.1/24 10.11.10.0 windsor/yorkshire windsor core
10.11.11.1/24 10.11.11.0 windsor modem
10.11.12.1/24 10.11.12.0 windsor/yorkshire windsor gateway
D 10.101.0.241/... 10.101.0.0 ether1-wan
7 items

MikroTik DHCP Server Config

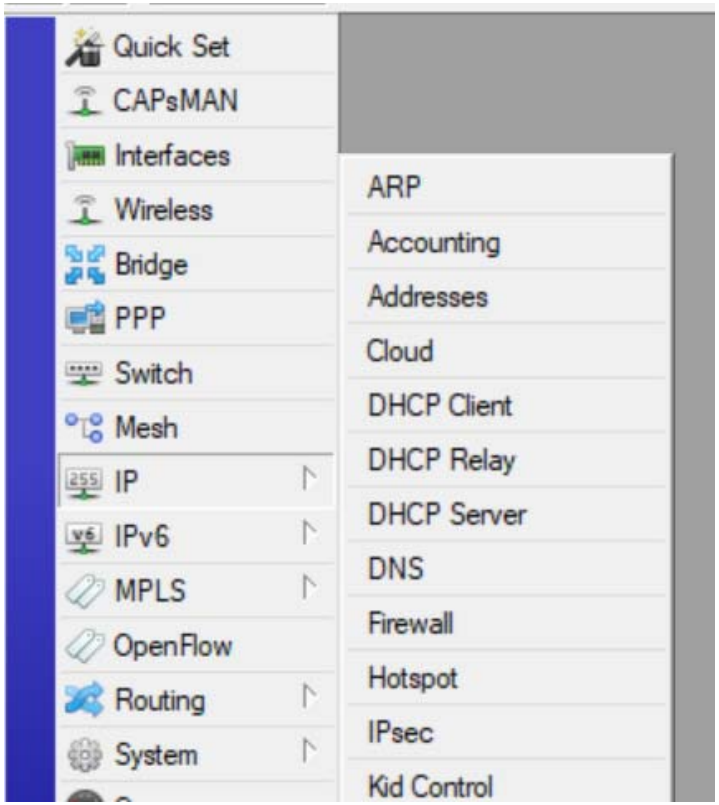
We need to have the MikroTik router provide several parameters to the modem

1. IP address, mask, gateway
2. TFTP server address
3. Boot File Name

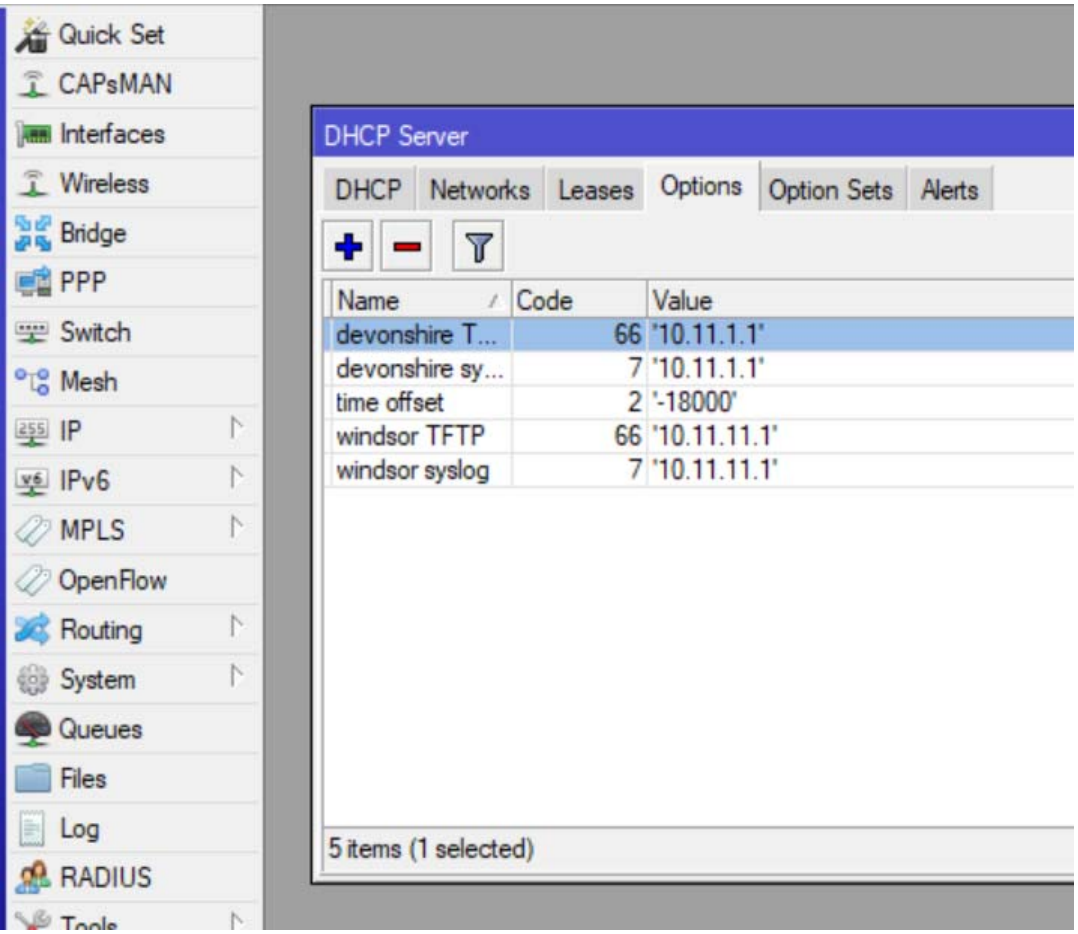
We also need to have the MikroTik provide parameters to the router

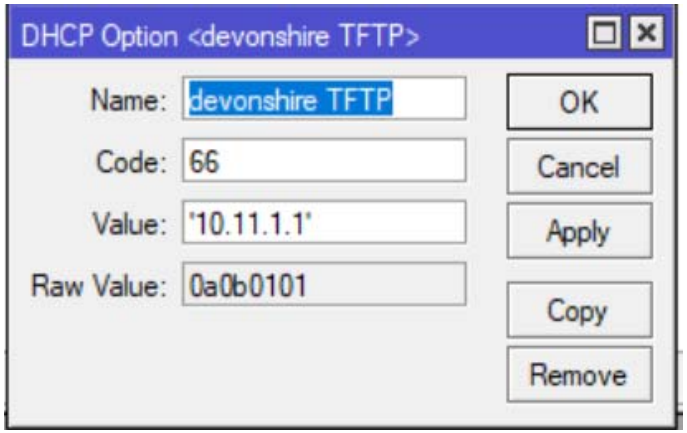
1. IP address
2. Subnet mask
3. Gateway
4. DNS server

IP DHCP SERVER

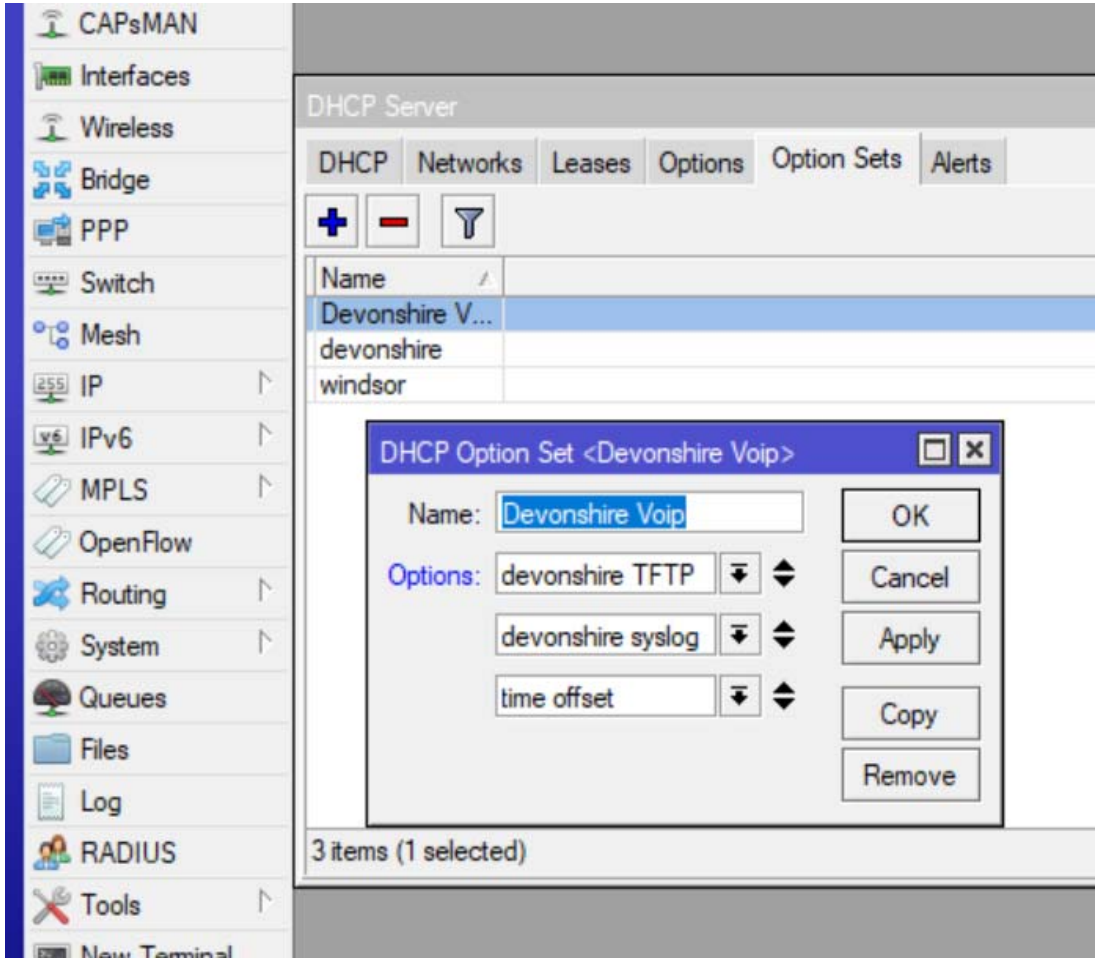


Set DHCP Options

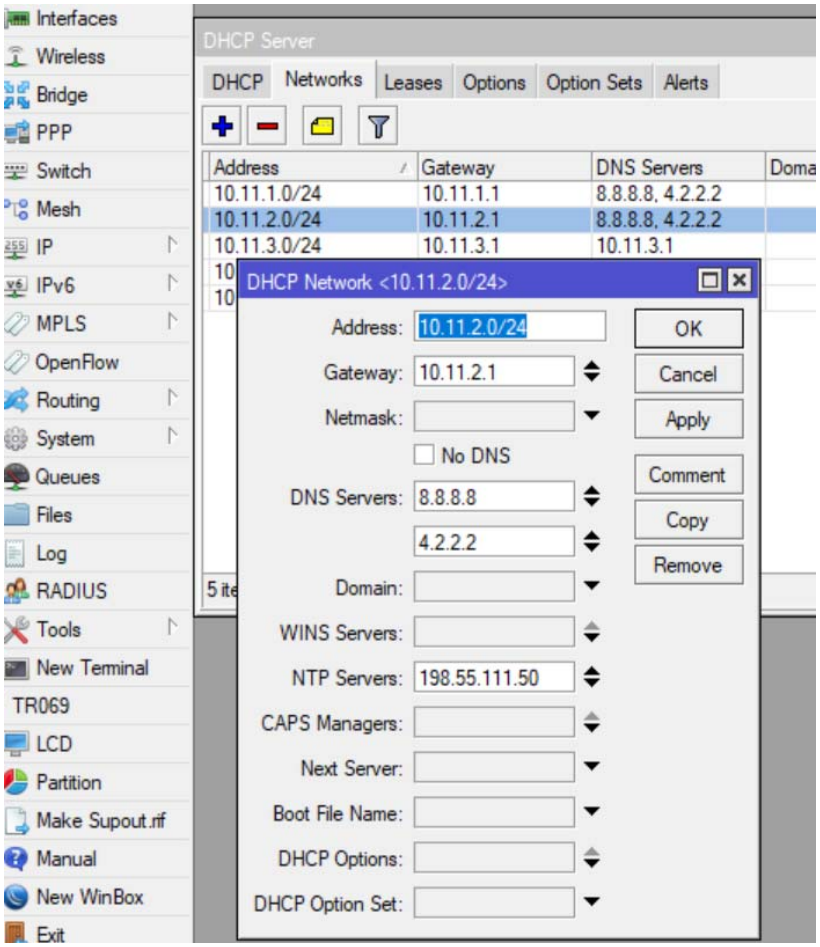




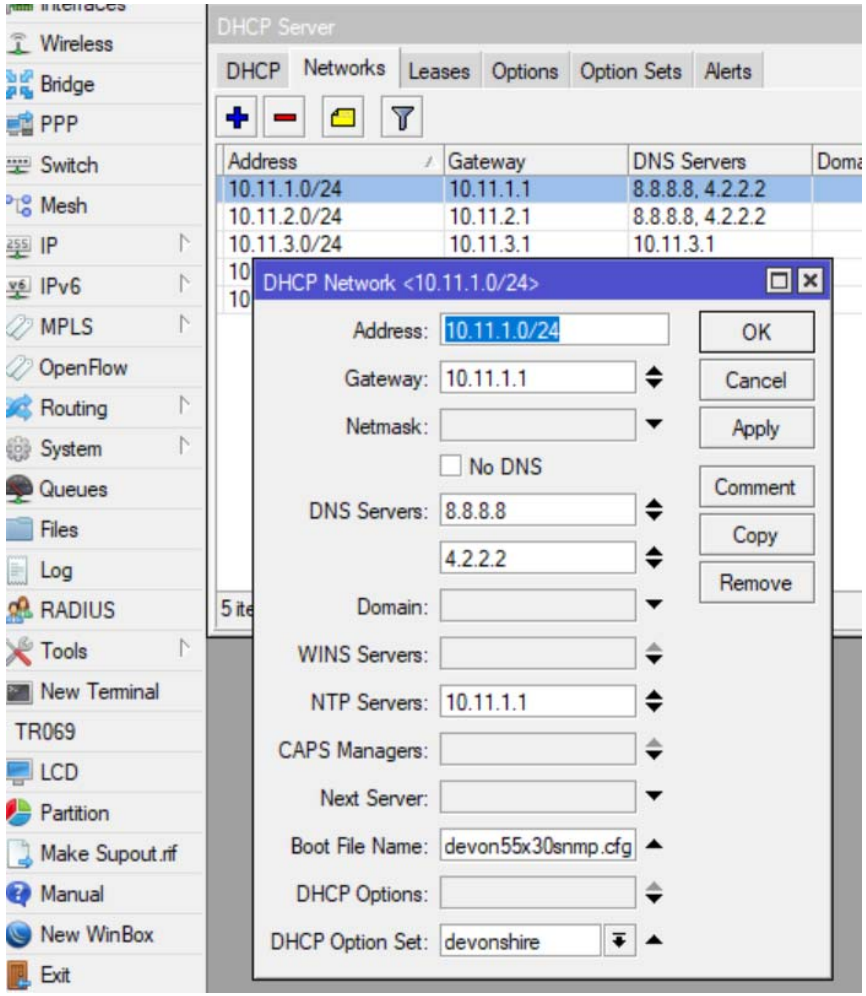
Set DHCP Option Set



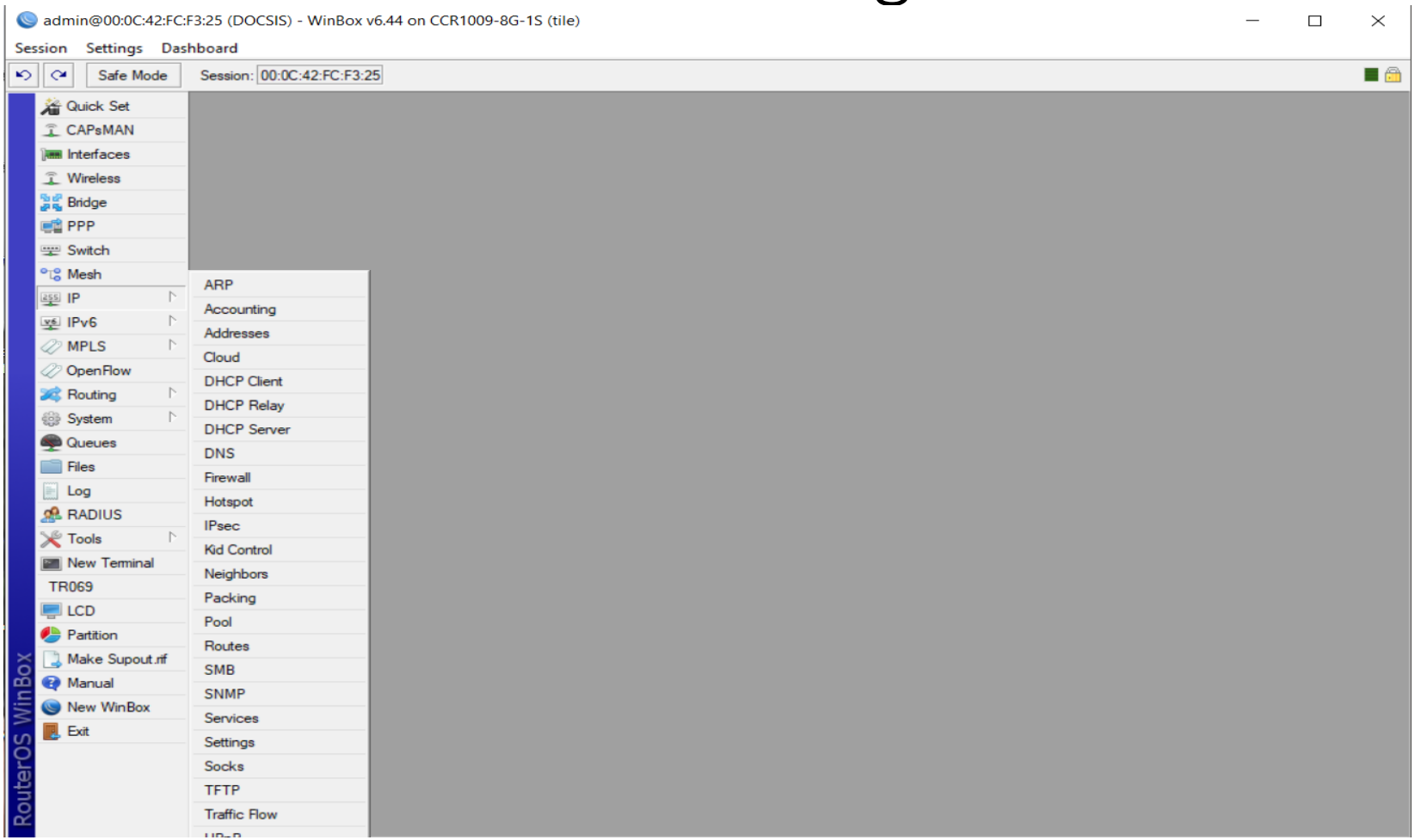
/IP DHCP SERVER/ NETWORK for routers



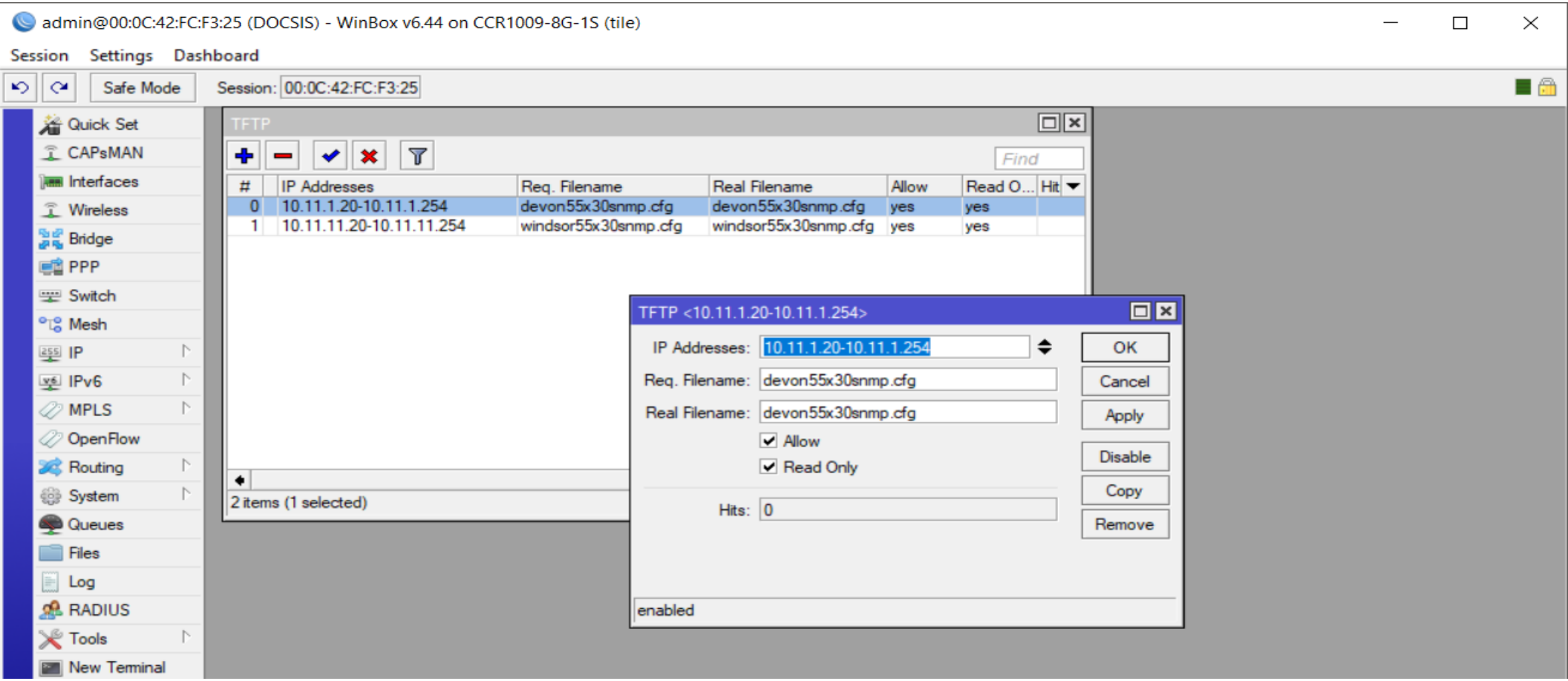
/IP DHCP SERVER/ NETWORK for modems



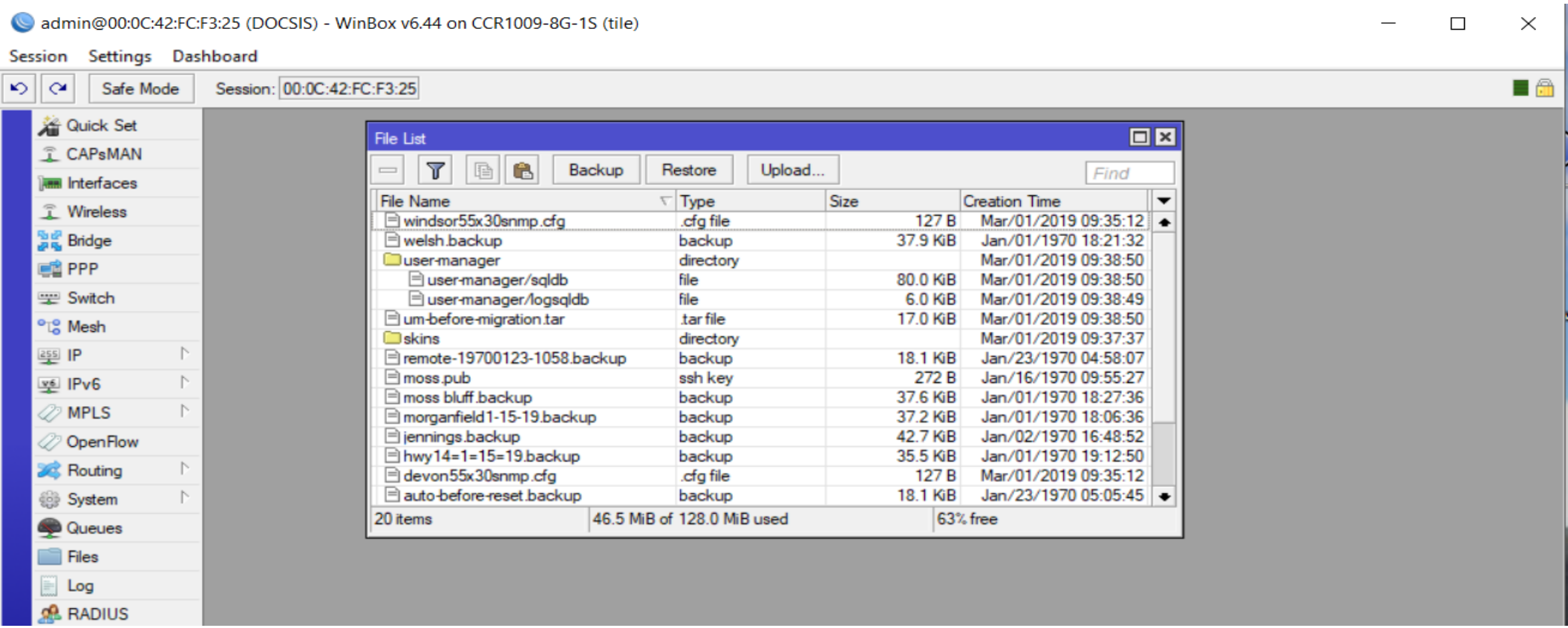
MikroTik TFTP SERVER Config



MikroTik IP TFTP Server



Put Modem Config File in /files



Modem Config Files

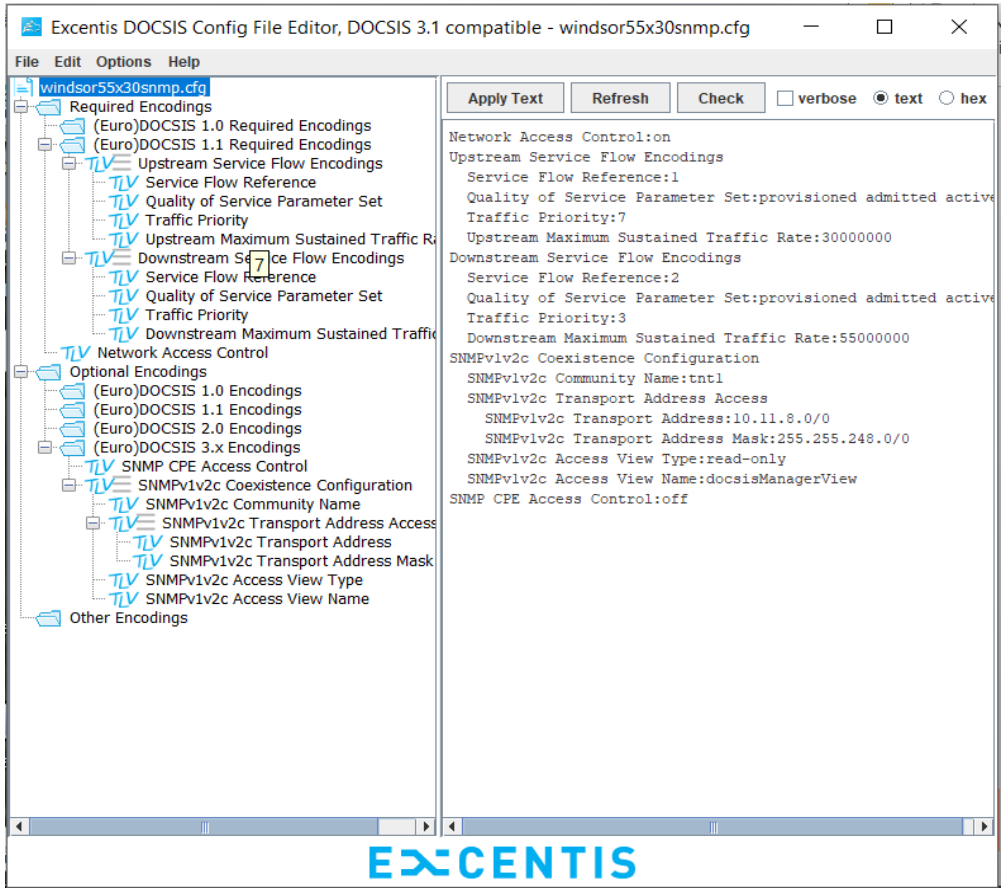
Docsis config files provide the info needed to configure the cable modem.

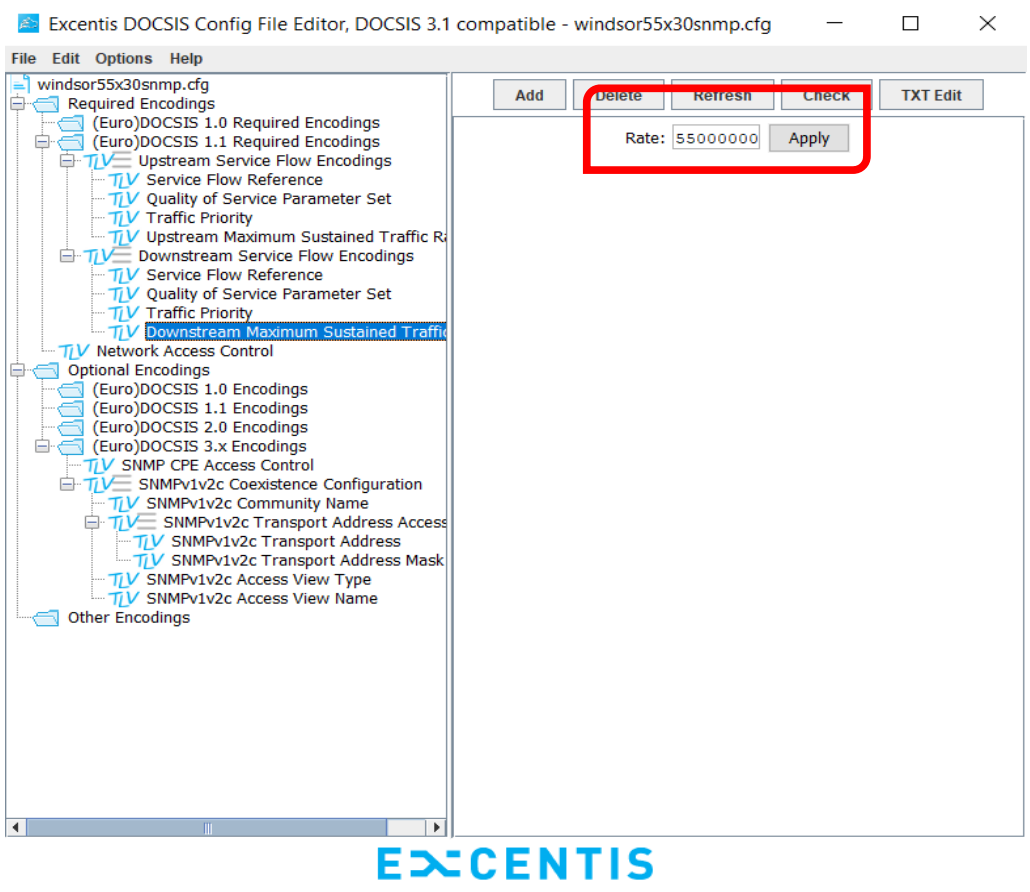
The config file we place in /files must be in “Docsis” binary format

You will need a config file editor
https://www.excentis.com/

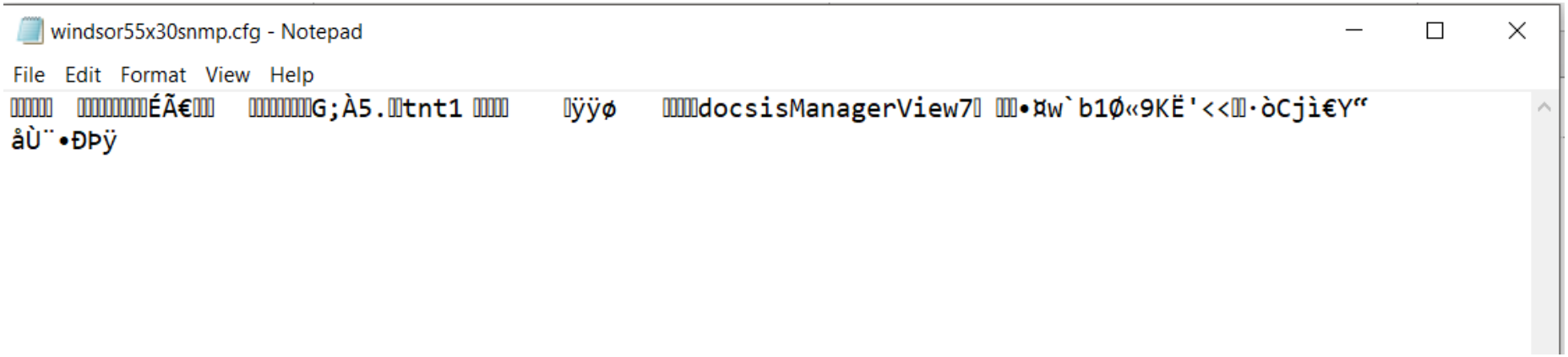
Some basic items would be:
upstream max traffic flow
downstream max traffic flow
whether or not customer can access modem
SNMP community names
address of SNMP server

Config file editor





File to upload



One or many config files?

In this case study, one config file is used for all modems with up and download speeds set at just over the maximum limits for the fastest service being sold.
Actual user bandwidth is controlled using address lists containing IP addresses of routers, not modems along with mangle rules and queue tree.

Another approach would be to control bandwidth at the modem with a different config file uploaded to modem for each speed package sold.

Still another would be a different config file for VOIP customers which would prioritize VOIP traffic at the modem.

Note that if you want to change a service by means of a different config file, you must reboot the selected modem for the new config file to be uploaded.

Numerous Deployment Options

ALL Dynamic Assignments

- Simple
- All same type modems
- All same services
- Example would be a hotel or student housing with modems behind Hotspot

Static Leases Assignments

- Paid service
- Different Speeds and services
- Ability to suspend service for non payment

Separate Subnets for devices and services

Under all but the simplest dynamic deployment, you can separate device types and services into separate subnets.

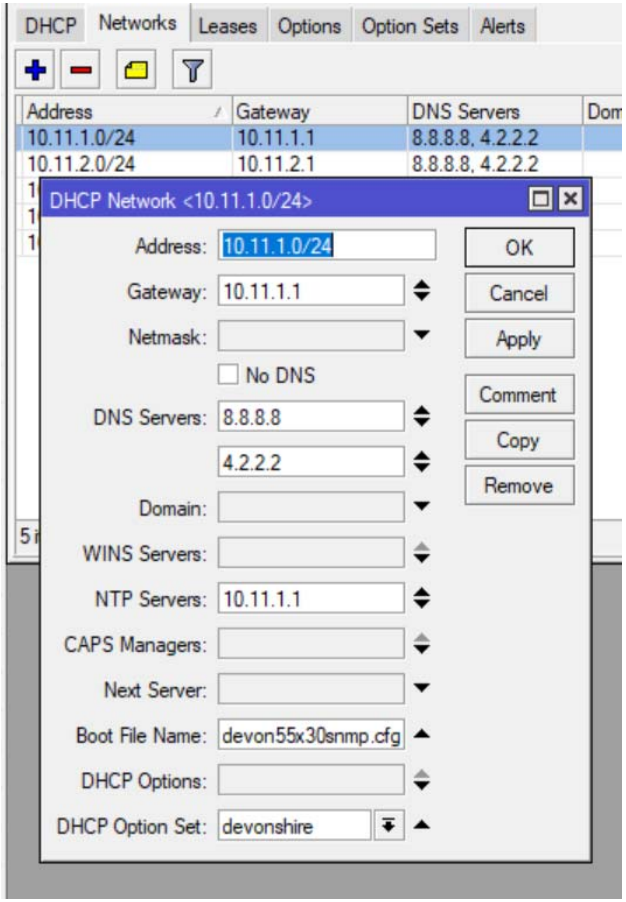
In this case study all modems are placed in subnet 1, and all routers into subnet 2.

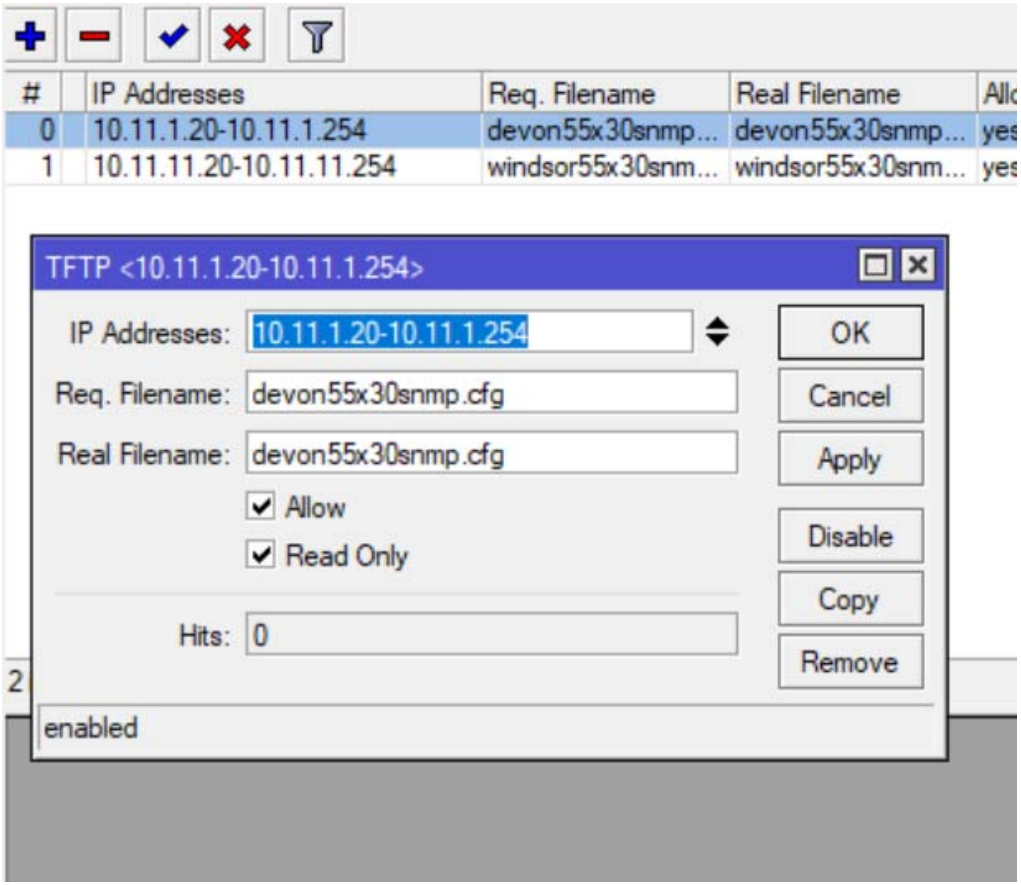
You can also separate different service levels into separate subnets by placing all routers with same bandwidth limit into one subnet and others with different bandwidth limit into a second. Or all VOIP customers in same subnet.

The reason for this is to control which modem config file gets delivered to a specific modem. Remember we have only one DHCP server per interface so config files are specified in the DHCP networks section as well as the TFTP server address list. We also need to write static dhcp leases.

It also becomes easier to control traffic flow based on subnet. For example you can block internet access for all modem subnets if not needed, restrict modem access to only what's needed, or Netmap different router subnets to different public IP's.

DHCP network and TFTP server

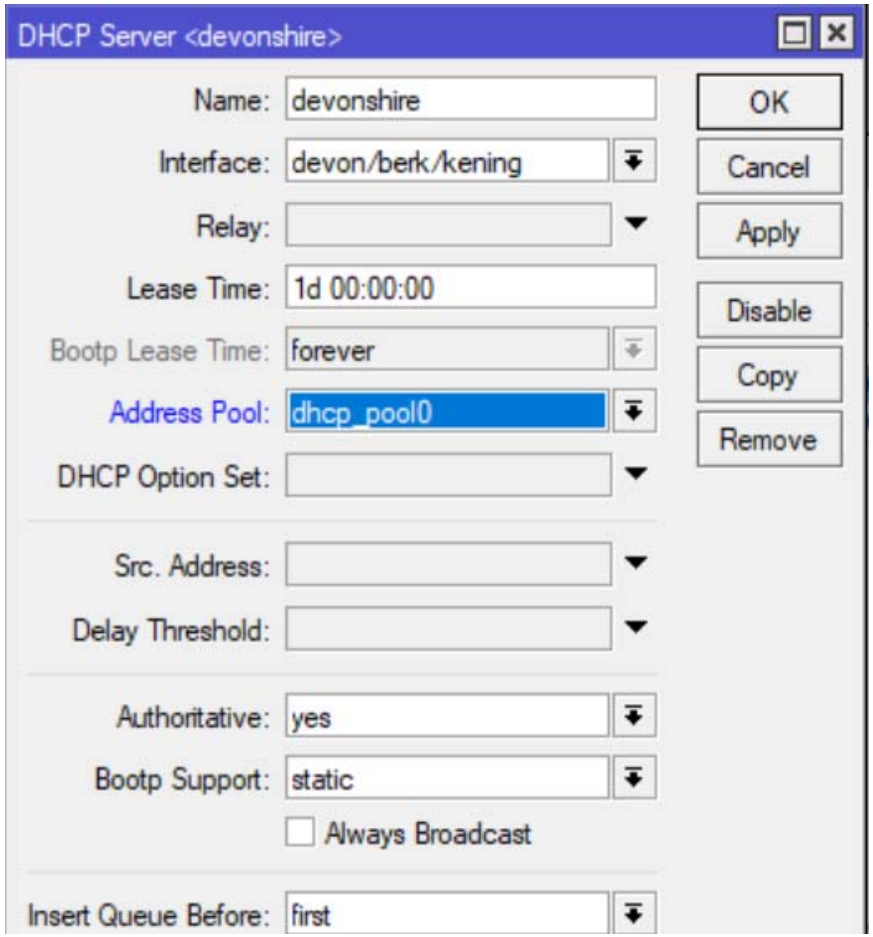


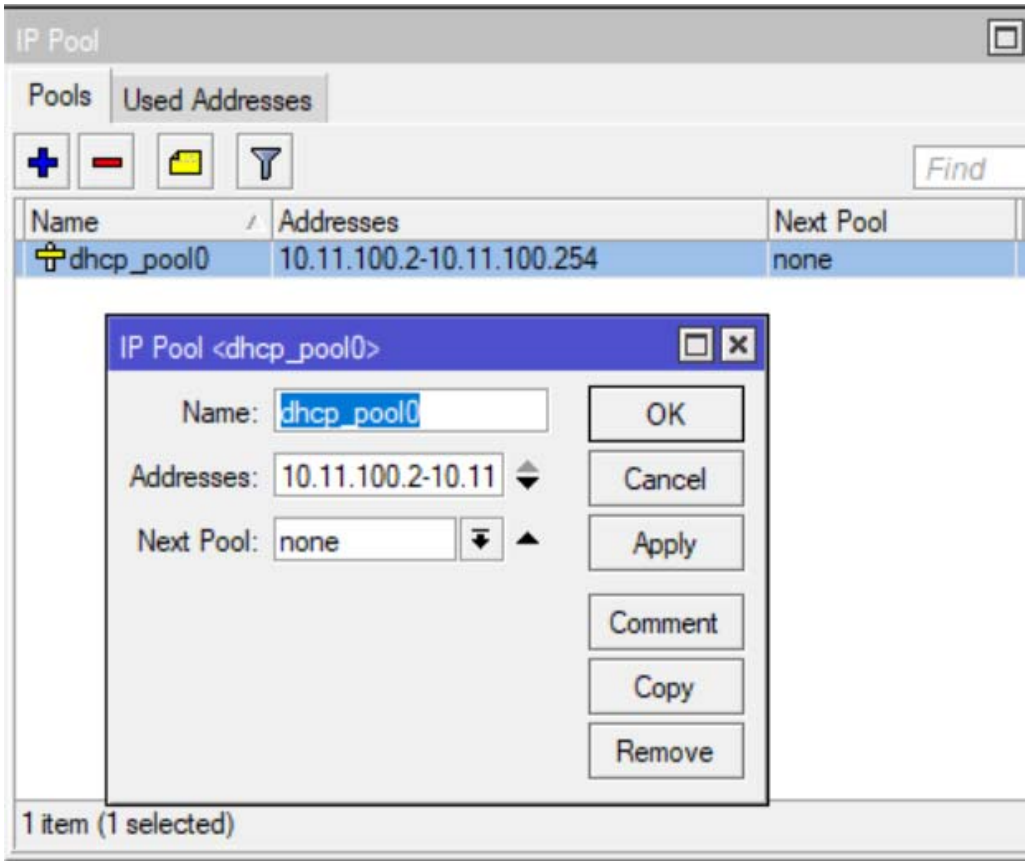


Dynamic Assignment

When all users have the same modems, service levels, bandwidth limitations, etc...
Such as in hotels or student housing then just use IP pools instead of static leases.
The options sets remain the same but the routers will ignore what they don’t need. For example the TFTP server address.
In the simplest case, the config file for the modem can rate limit users without the need for queuing on main MikroTik router.

Add IP pool to DHCP server



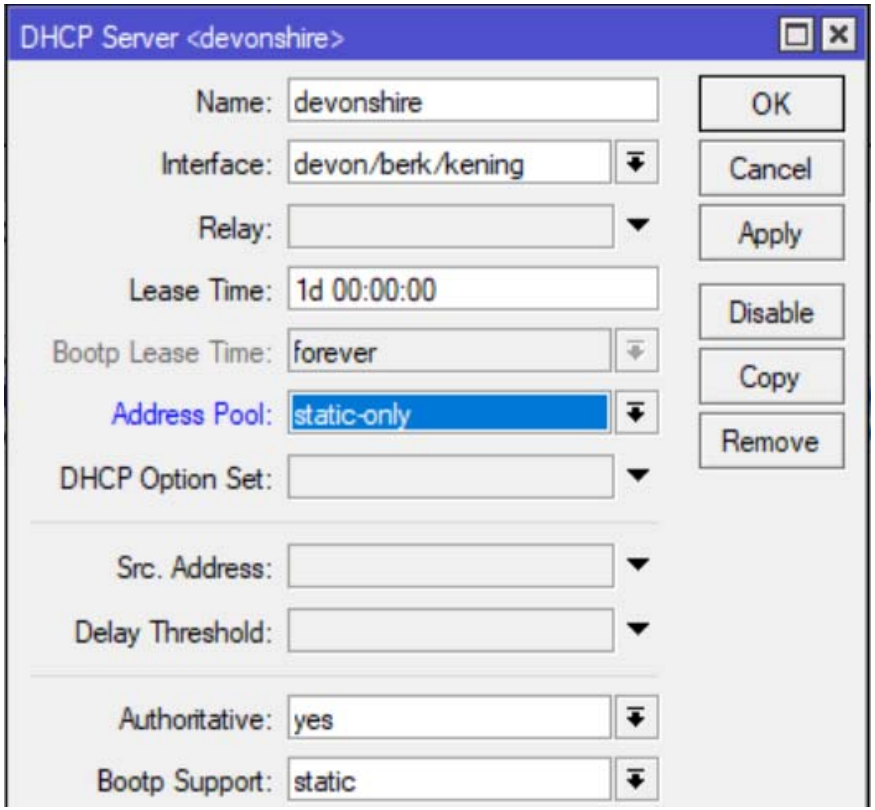


Static Lease Assignments

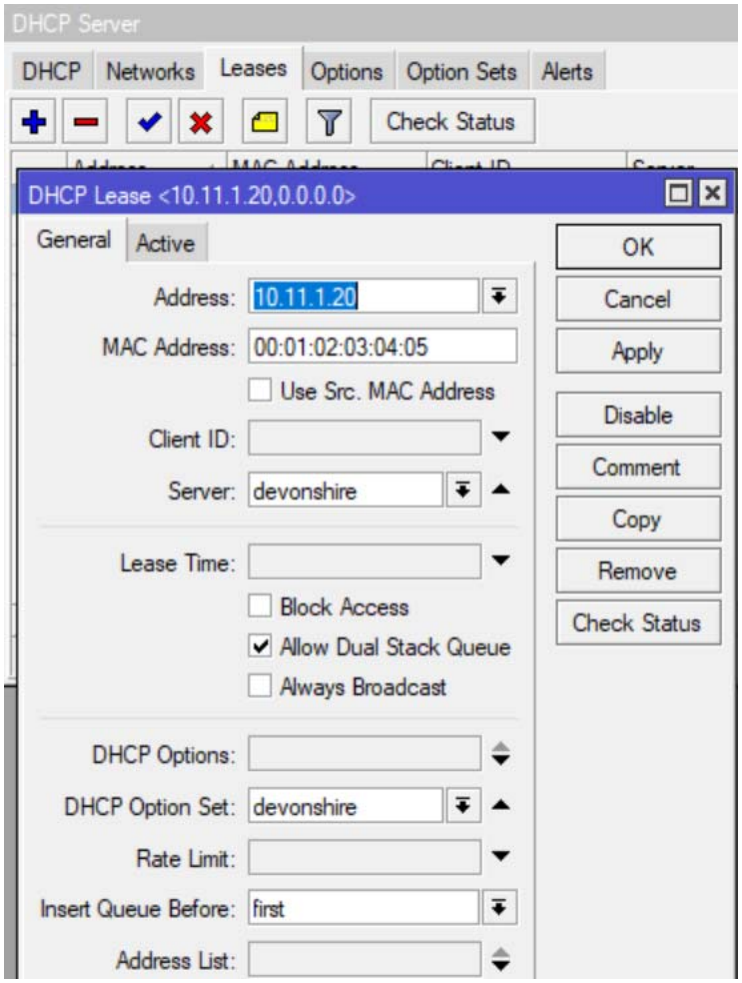
Various ways can be deployed to write static leases:

1. Manually enter the mac and IP address for each both modem and router
2. Integration of third party billing platforms either local, remote, or cloud based
3. Radius server (MikroTik Usermanager)

Write Leases Manually



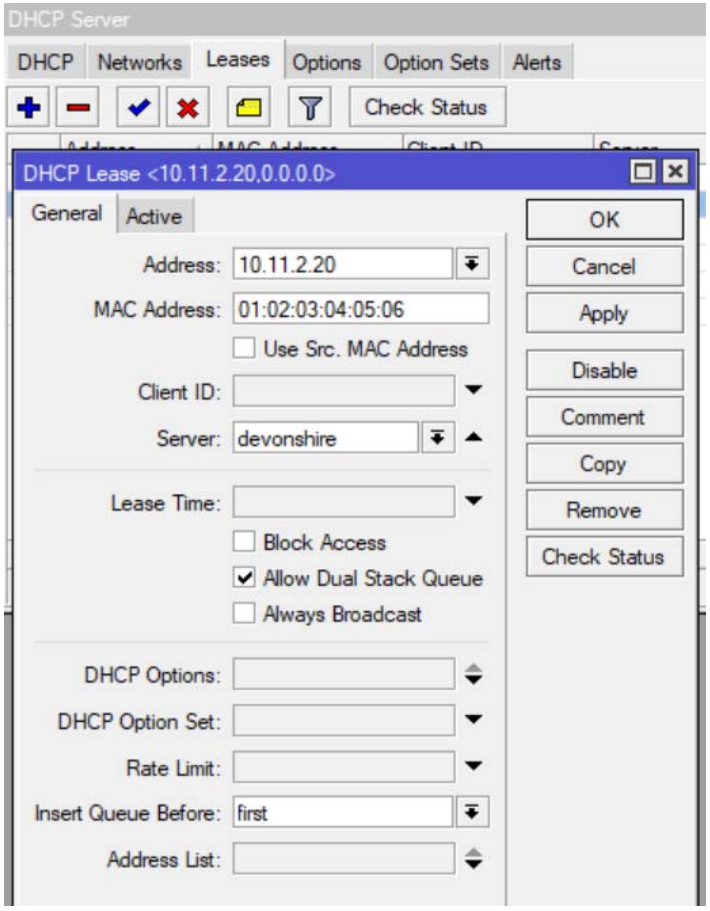
Add Modem



Add first modem's mac address, IP address, and option set

All Modem IP address will be issued from one subnet

Add Router



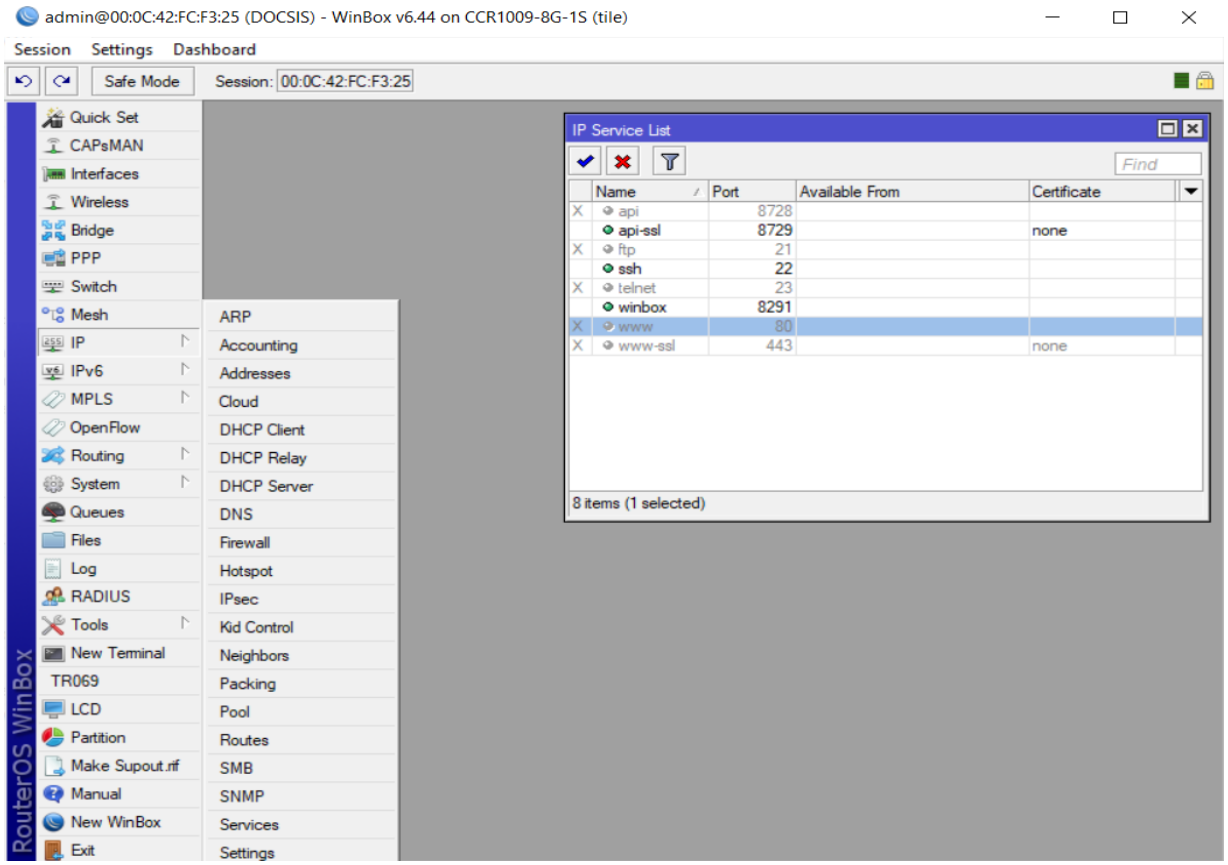
Add first router's mac address and IP address,
All router IP addresses will be issued from separate subnet

Third party cloud based

Mac addresses for both modem and router are entered and associated with a customer and IP addresses are assigned.
A service is also associated with the customer indicating bandwidth limits

Router is updated via API and static leases are written as well as address list entries

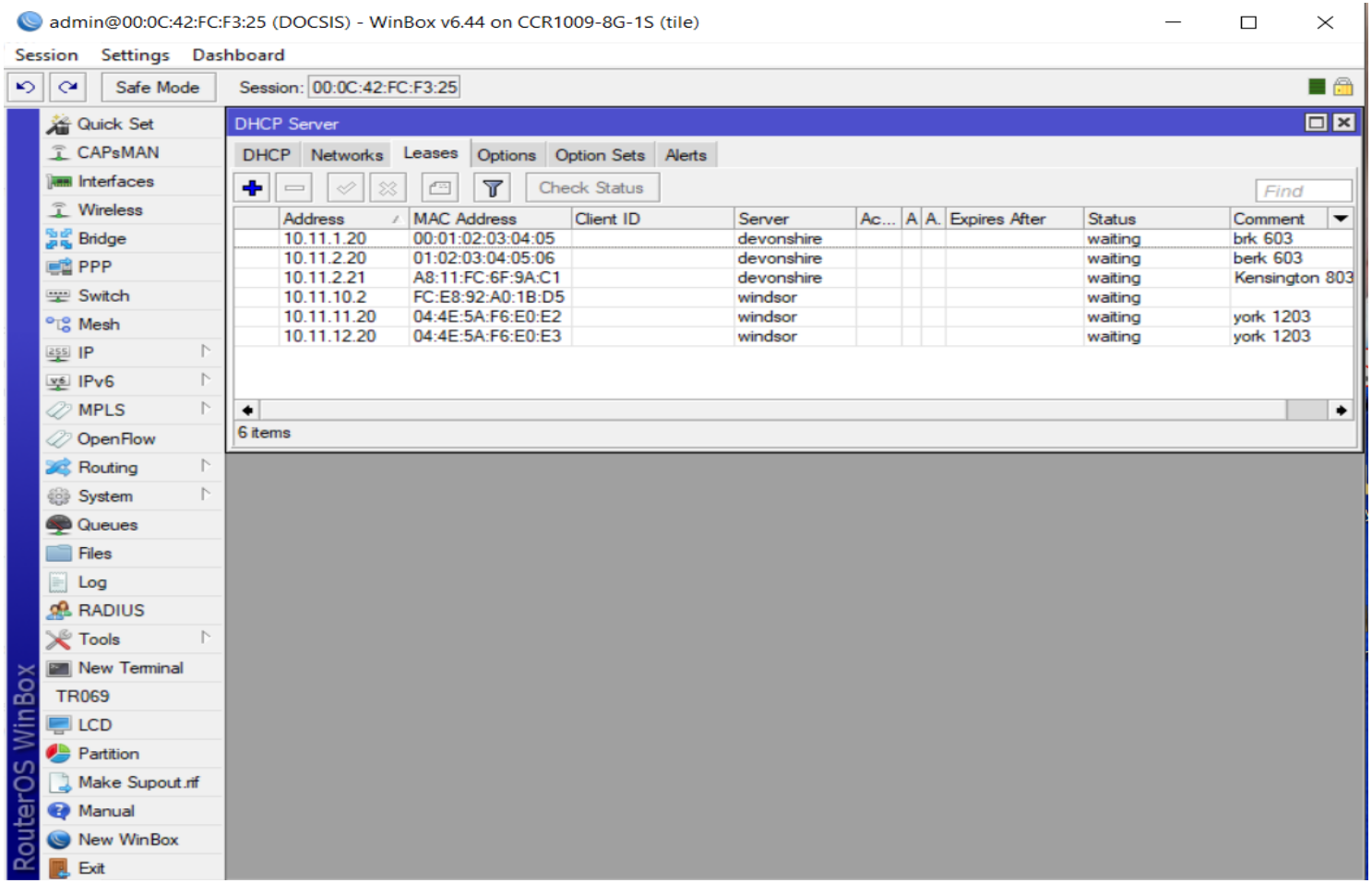
Enable API Service



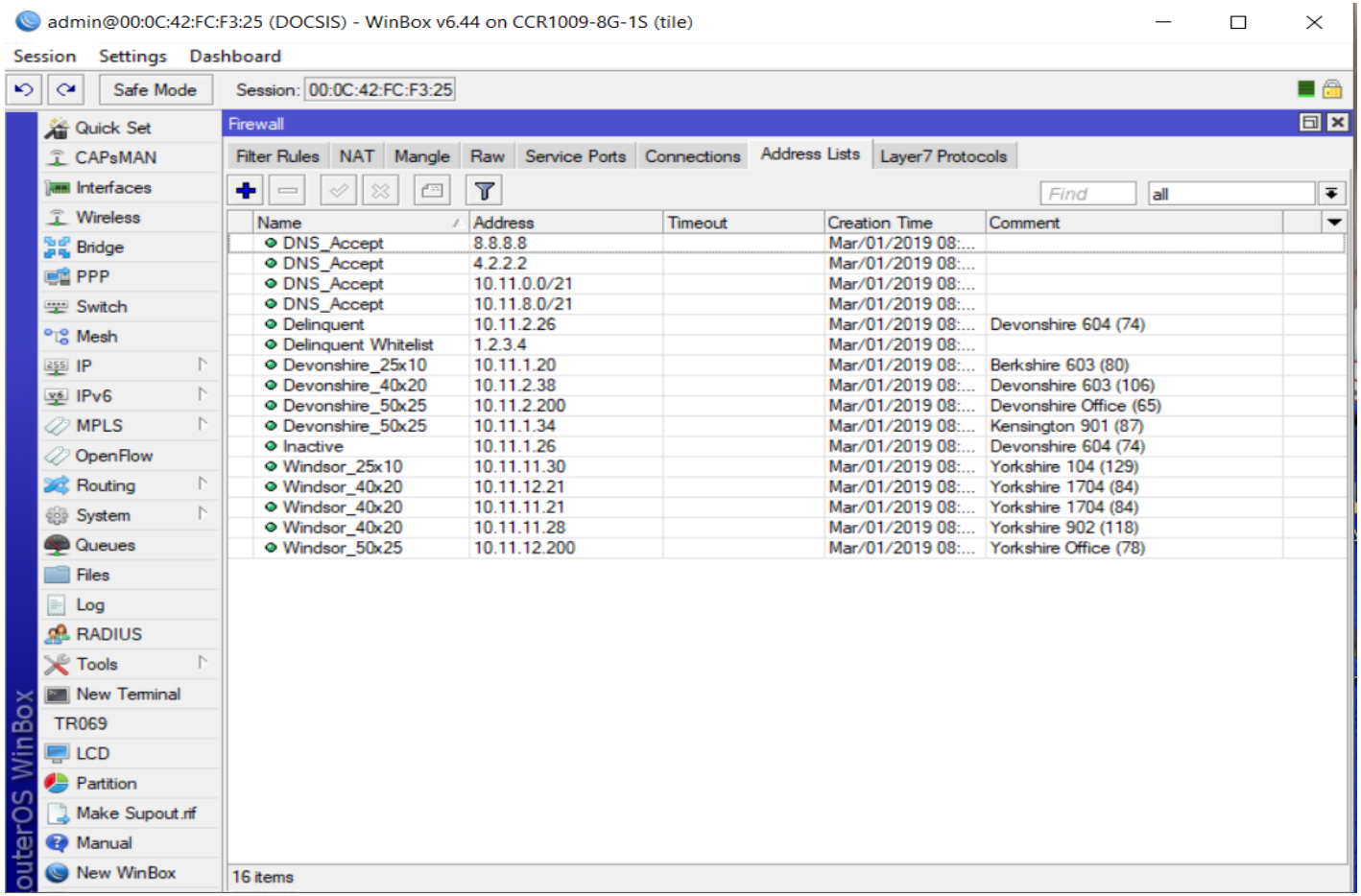
Enable API service

Make sure to allow access only from authorized IP address and create certificate if using API-SSL

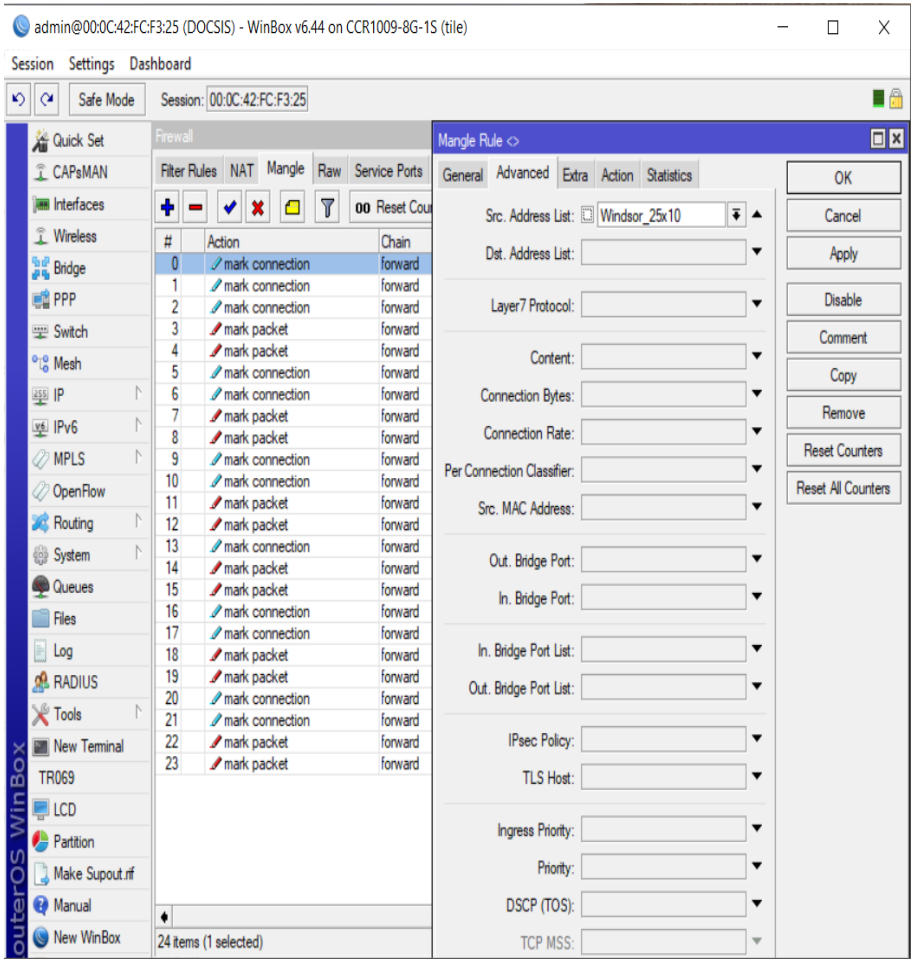
Static Leases written

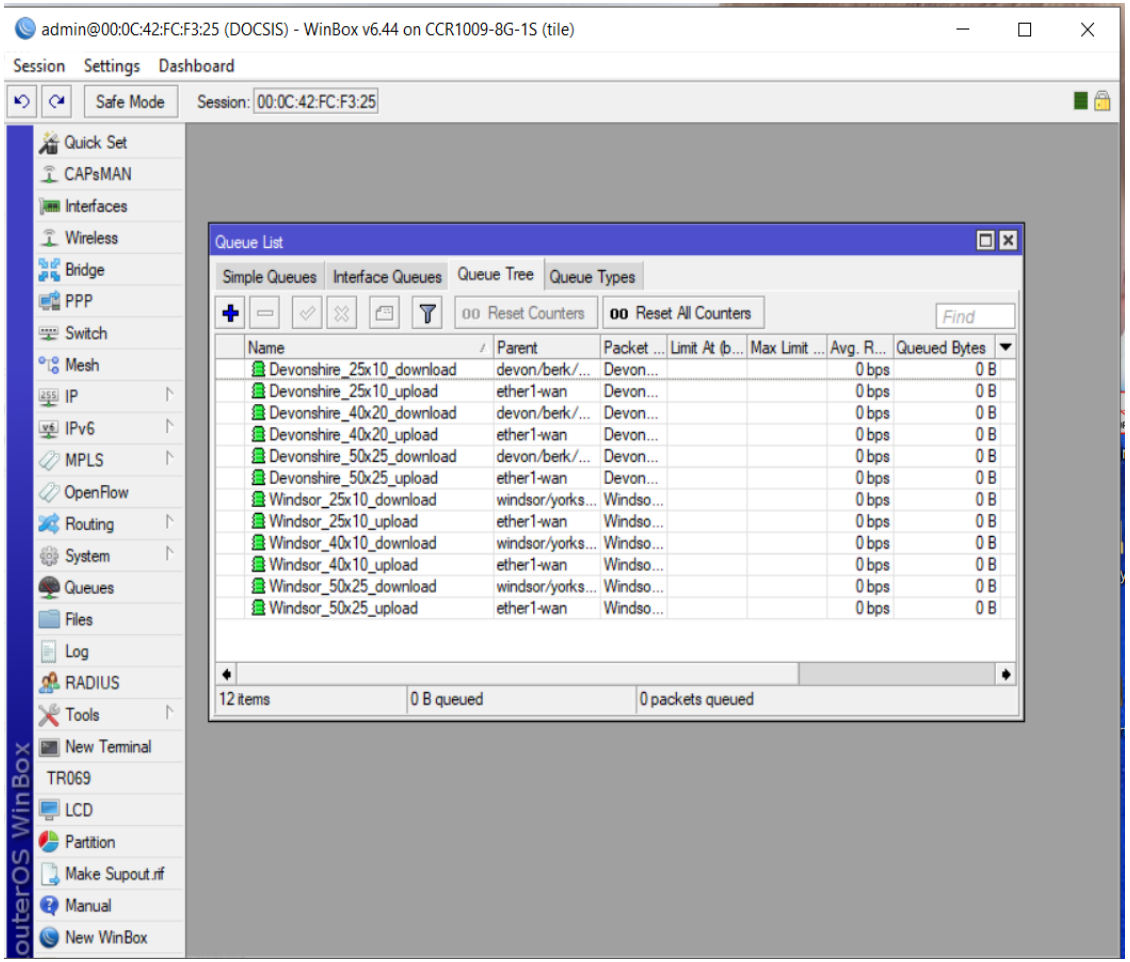


Address list updated

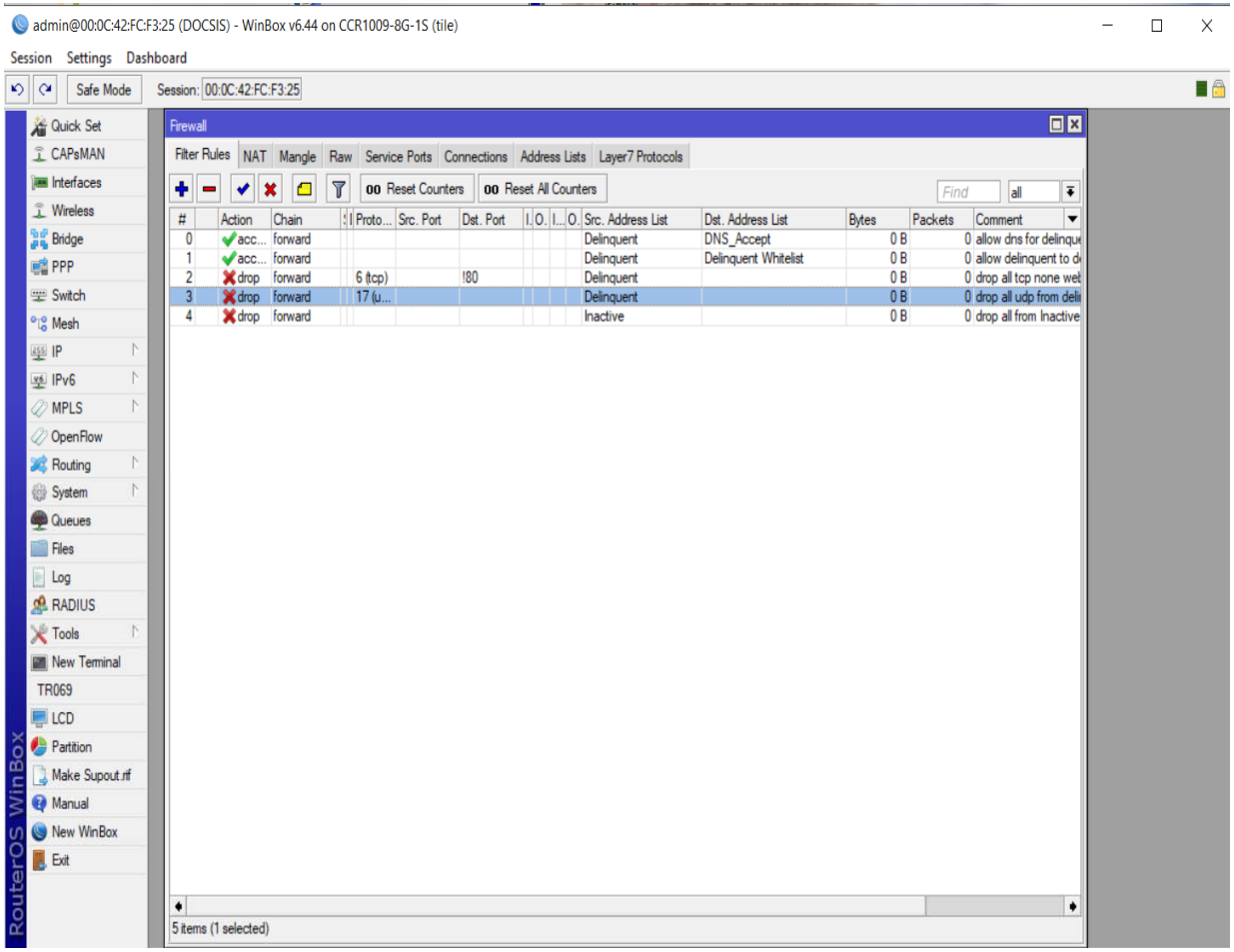


Mangle and Queue Tree Based on address lists

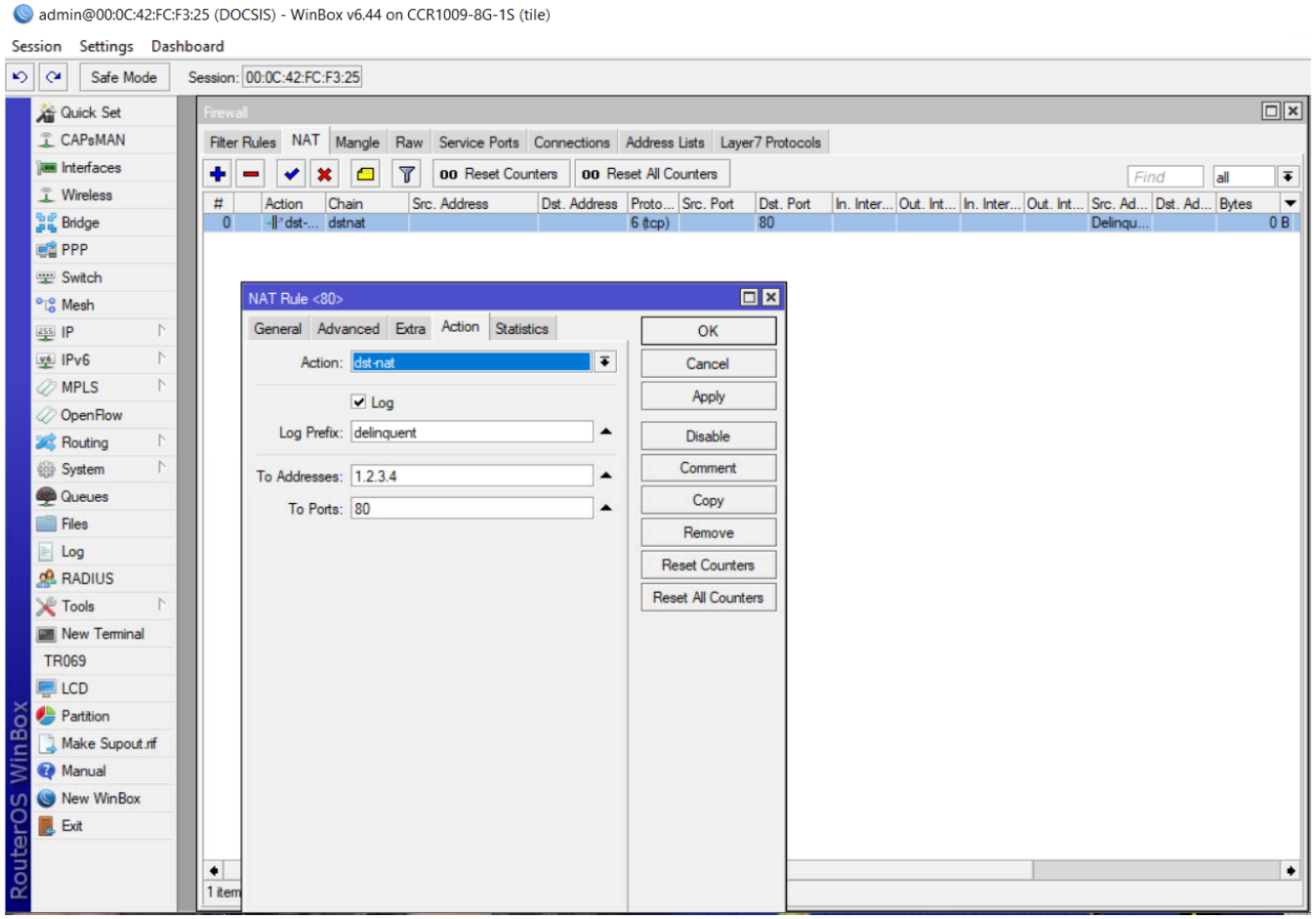




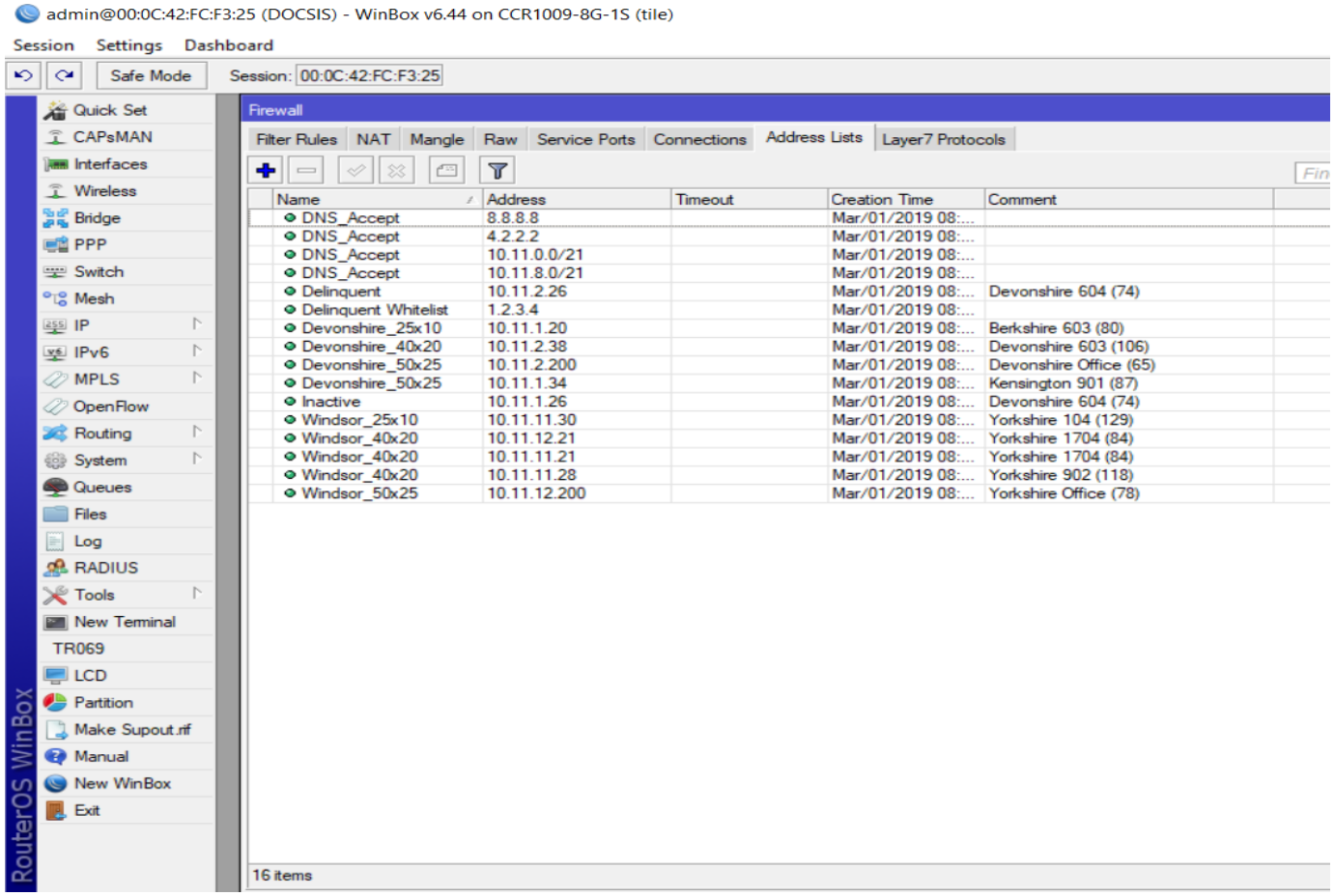
Redirect for non payment



Redirect for non payment



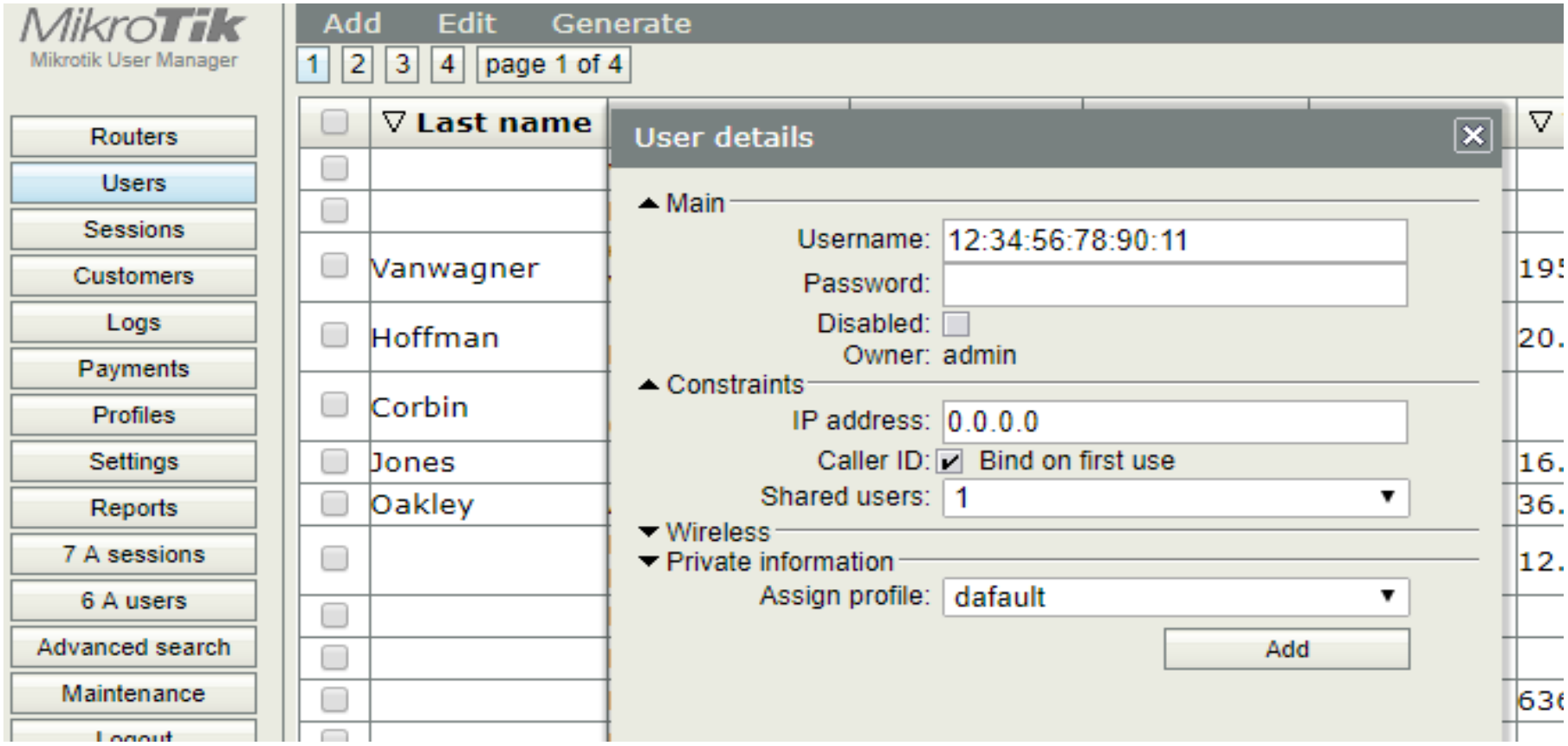
Inactive or Suspended



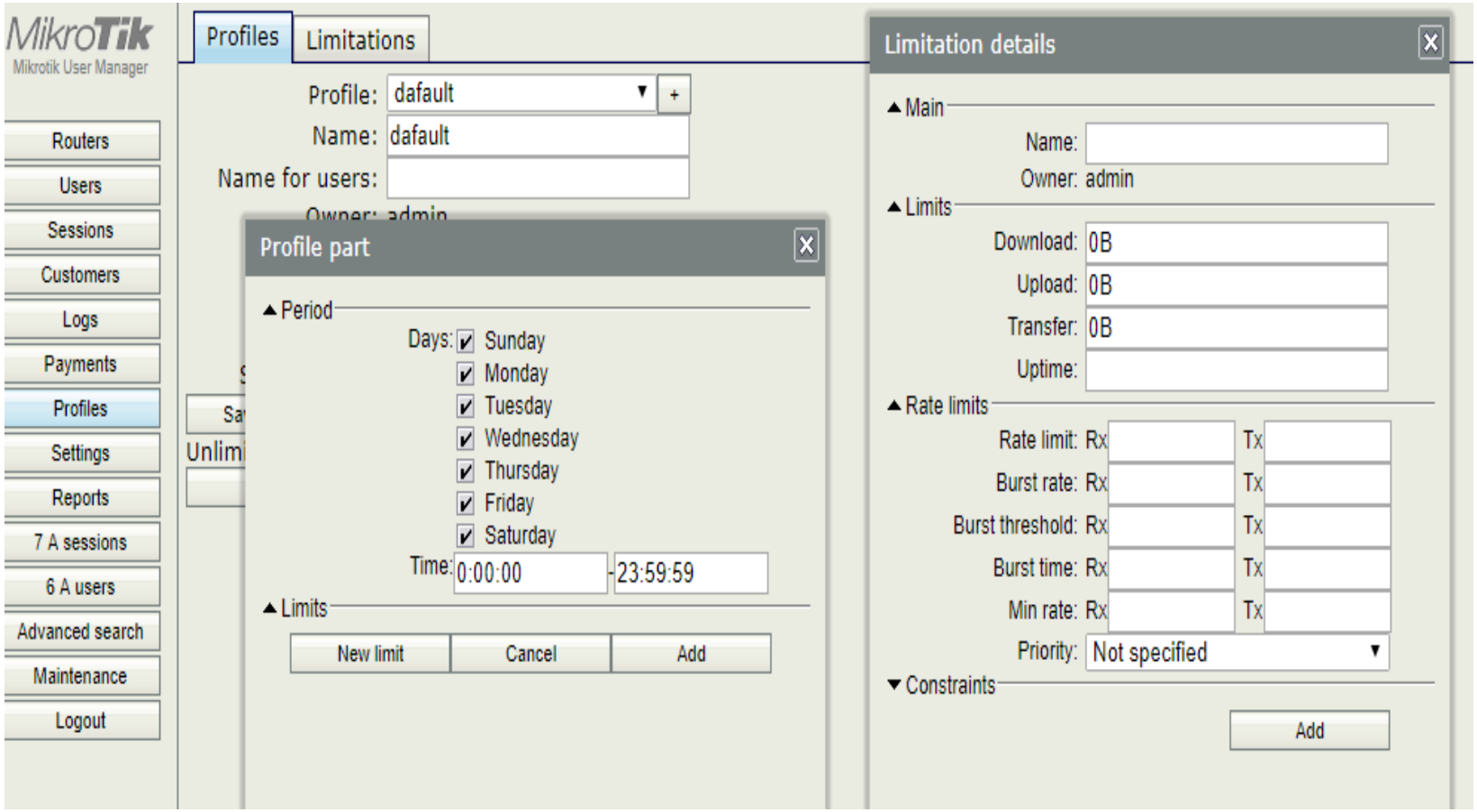
UserManager

We could use the built in Usermanager to write static DHCP leases with mac address as username then add profiles and limitations

Add User


MikroTik
Mikrotik User Manager
Routers
Users
Sessions
Customers
Logs
Payments
Profiles
Settings
Reports
7 A sessions
6 A users
Advanced search
Maintenance
Add
Edit
Generate
1
2
3
4
page 1 of 4
Last name
Vanwagner
Hoffman
Corbin
Jones
Oakley
User details
Main
Username: 12:34:56:78:90:11
Password:
Disabled:
Owner: admin
Constraints
IP address: 0.0.0.0
Caller ID: Bind on first use
Shared users: 1
Wireless
Private information
Assign profile: dafault
Add

Userman profile and limitation



Hotspot

Although not covered here we could also use Hotspot

SUMMARY

The only real difference between a Docsis based network and an Ethernet or wireless based network other than the physical layer protocols is the need to deliver config files to the modems.

While there is a need for expensive Docsis provisioning software and servers on large complex networks this case study shows how to build a working solution using only a MikroTik edge router.