Úvod

Správa síťových zařízení MikroTik 1. přednáška

verze 2024.1

Obsah přednášky

- Organizační informace
- MTCNA certifikace
- MikroTik – společnost
- Úvodní konfigurace zařízení
- Upgrade a instalace balíčků
- Záloha konfigurace
- Netinstall
- Licence

Organizační informace

Organizační informace

- Vyučující
  - Jiří Balej (jiri.balej@mendelu.cz) – přednášky, cvičení
  - Andrej Juríčka (andrej.juricka@mendelu.cz) – cvičení

- Harmonogram
  - viz dokumentový server

- Podmínky pro úspěšné dokončení
  - 4x úkol na cvičení/8x domácí úkol
  - praktická zkouška
  - certifikační zkouška

MTCNA certifikace

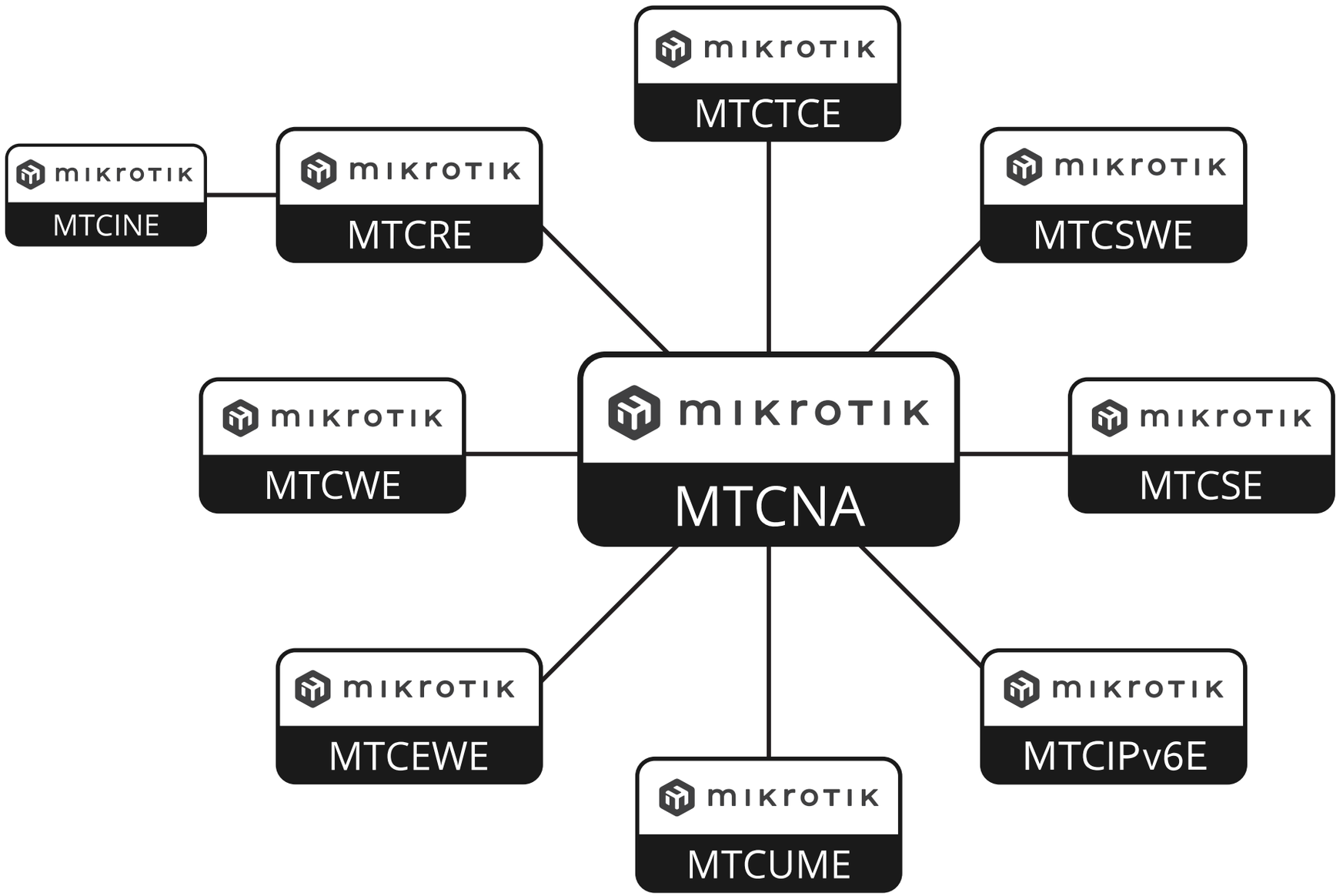
Course Objectives

- Provide an overview of RouterOS software and RouterBOARD products
- Hands-on training for MikroTik router configuration, maintenance and basic troubleshooting

Learning Outcomes

- The student will:
- Be able to configure, manage and do basic troubleshooting of a MikroTik RouterOS device
- Be able to provide basic services to clients
- Have a solid foundation and valuable tools to manage a network

MikroTik Certified Courses



For more info see: http://training.mikrotik.com

MTCNA Outline

- Module 1: Introduction
- Module 2: DHCP
- Module 3: Bridging
- Module 4: Routing
- Module 5: Wireless
- Module 6: Firewall
- Module 7: QoS
- Module 8: Tunnels
- Module 9: Misc

MikroTik – společnost

About MikroTik

- Router software and hardware manufacturer
- Products used by ISPs, companies and individuals
- Mission: to make Internet technologies faster, more powerful and affordable to a wider range of users

About MikroTik

- 1996: Established
- 1997: RouterOS software for x86 (PC)
- 2002: First RouterBOARD device
- 2006: First MikroTik User Meeting (MUM)
  - Prague, Czech Republic
- 2015: Biggest MUM: Indonesia, 2500+
- 2021: More than 250 different products

About MikroTik

- Located in Latvia
- 300+ employees
- mikrotik.com
- routerboard.com

MikroTik RouterOS

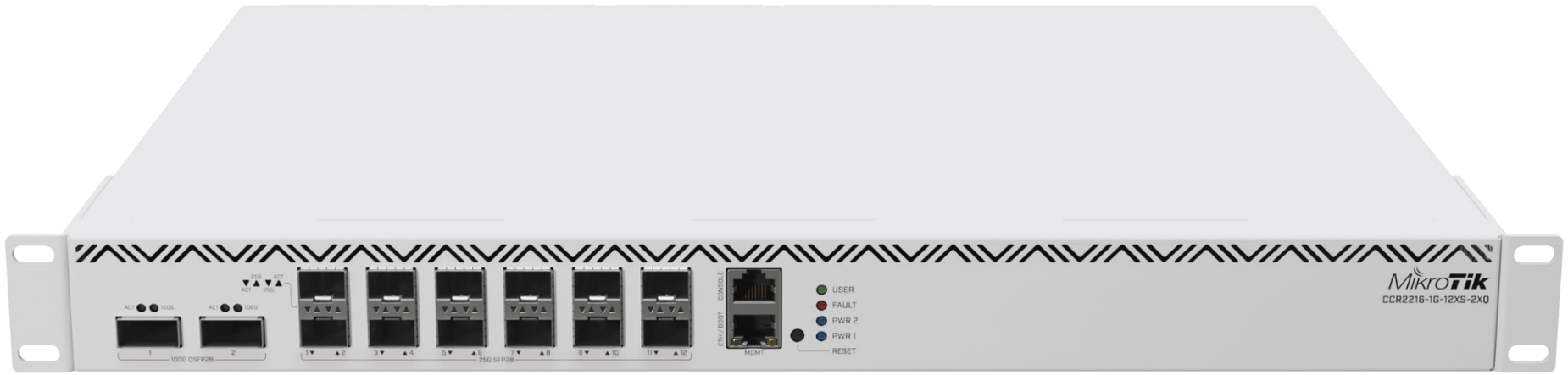
- Is the operating system of MikroTik RouterBOARD hardware
- Can also be installed on a PC or as a virtual machine (VM) – prepared CHR version
- Stand-alone operating system based on the Linux kernel

RouterOS Features

- Full 802.11 a/b/g/n/ac/ax support
- Firewall/bandwidth shaping
- Point-to-Point tunnelling (PPTP, PPPoE, SSTP, OpenVPN, WireGuard)
- DHCP/Proxy/HotSpot
- And many more… see: https://help.mikrotik.com/docs/

MikroTik RouterBOARD

- A family of hardware solutions created by MikroTik that run RouterOS
- Ranging from small home routers to carrier-class access concentrators
- Millions of RouterBOARDs are currently routing the world



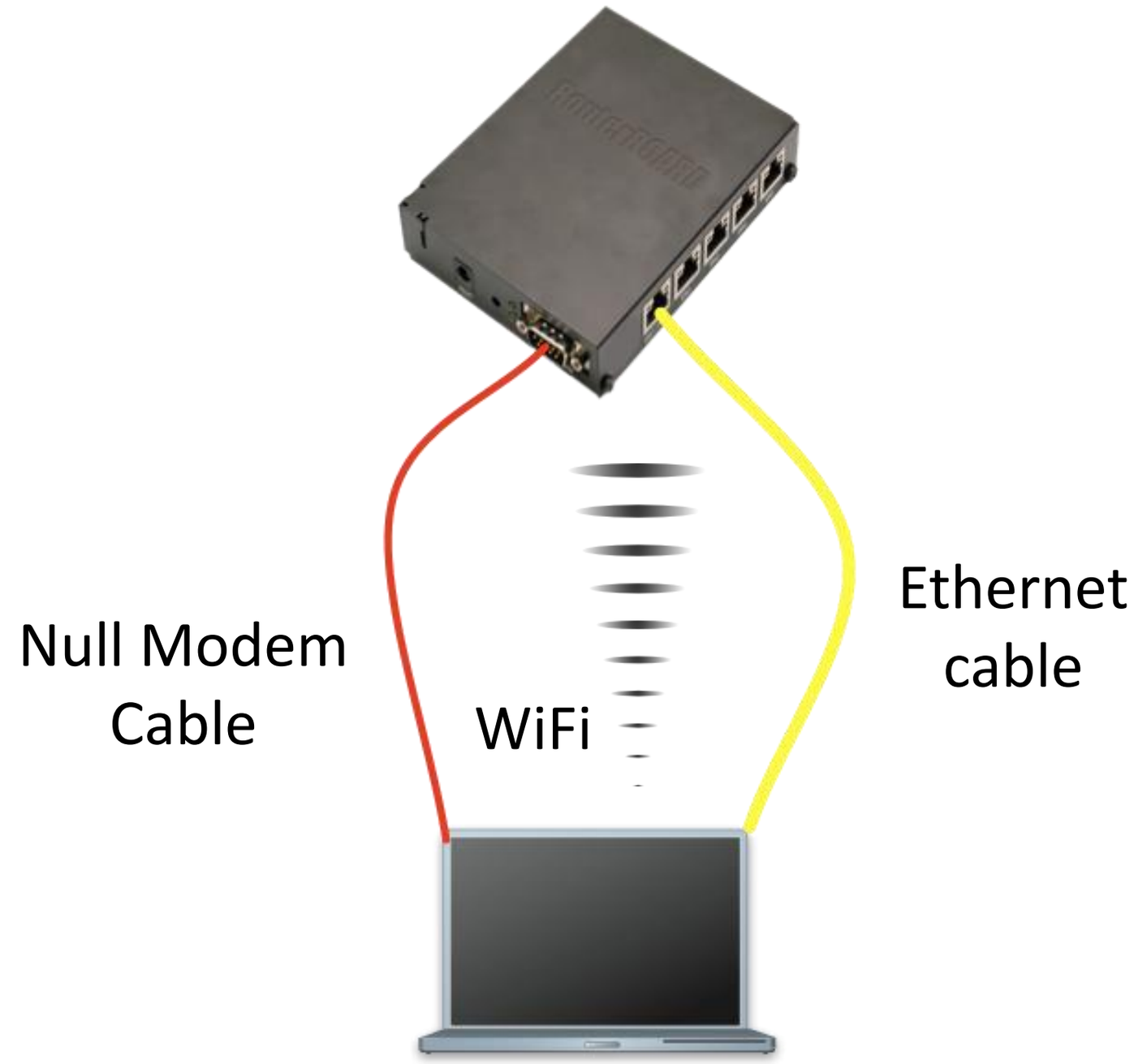
MikroTik RouterBOARD

- Integrated solutions - ready to use
- Boards only - for assembling own system
- Enclosures - for custom RouterBOARD builds
- Interfaces - for expanding functionality
- Accessories

Úvodní konfigurace zařízení

First Time Access

- Null modem cable
- Ethernet cable
- WiFi

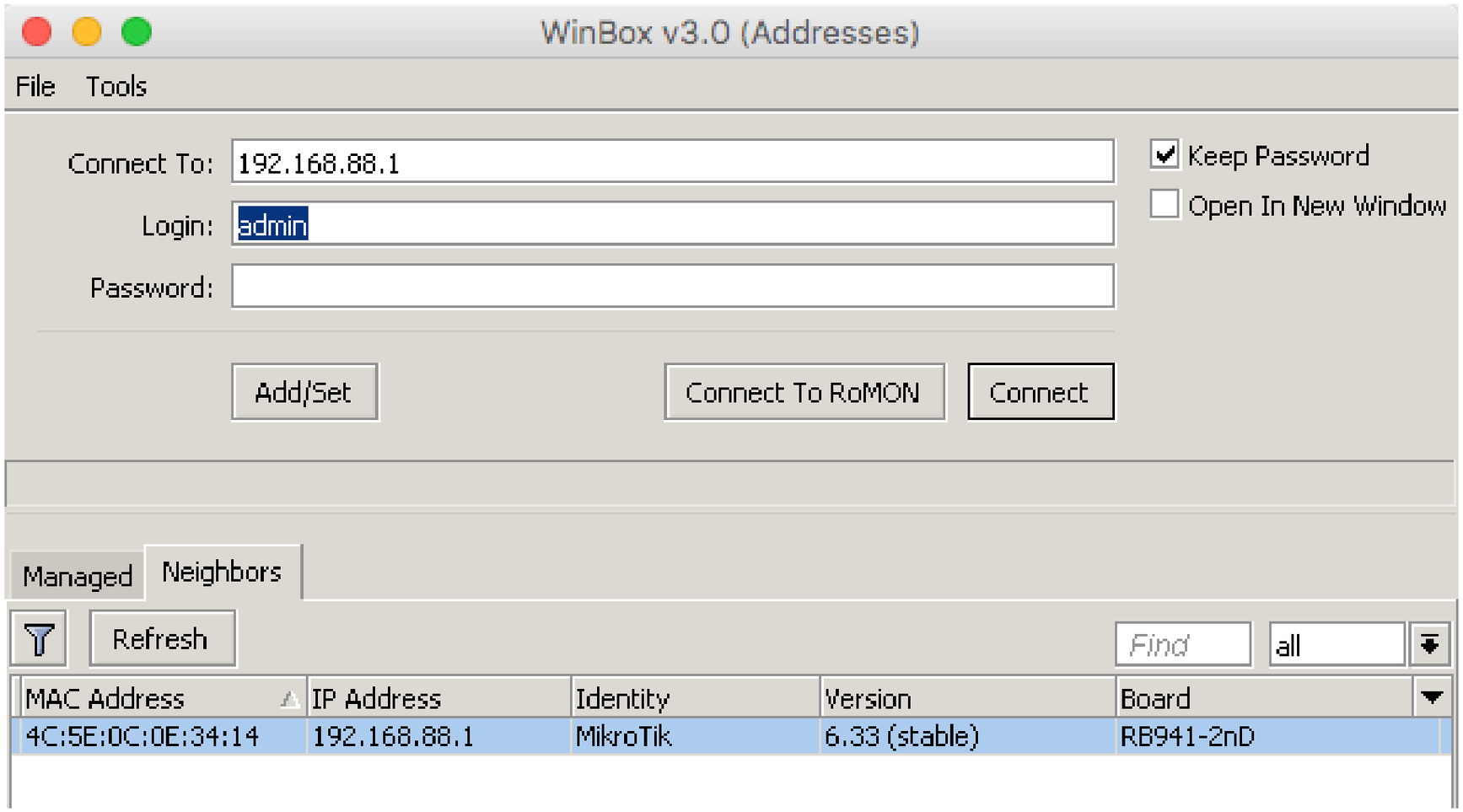


First Time Access

- WinBox - http://www.mikrotik.com/download/winbox.exe
- WebFig
- SSH
- Telnet
- Terminal emulator in case of serial port connection

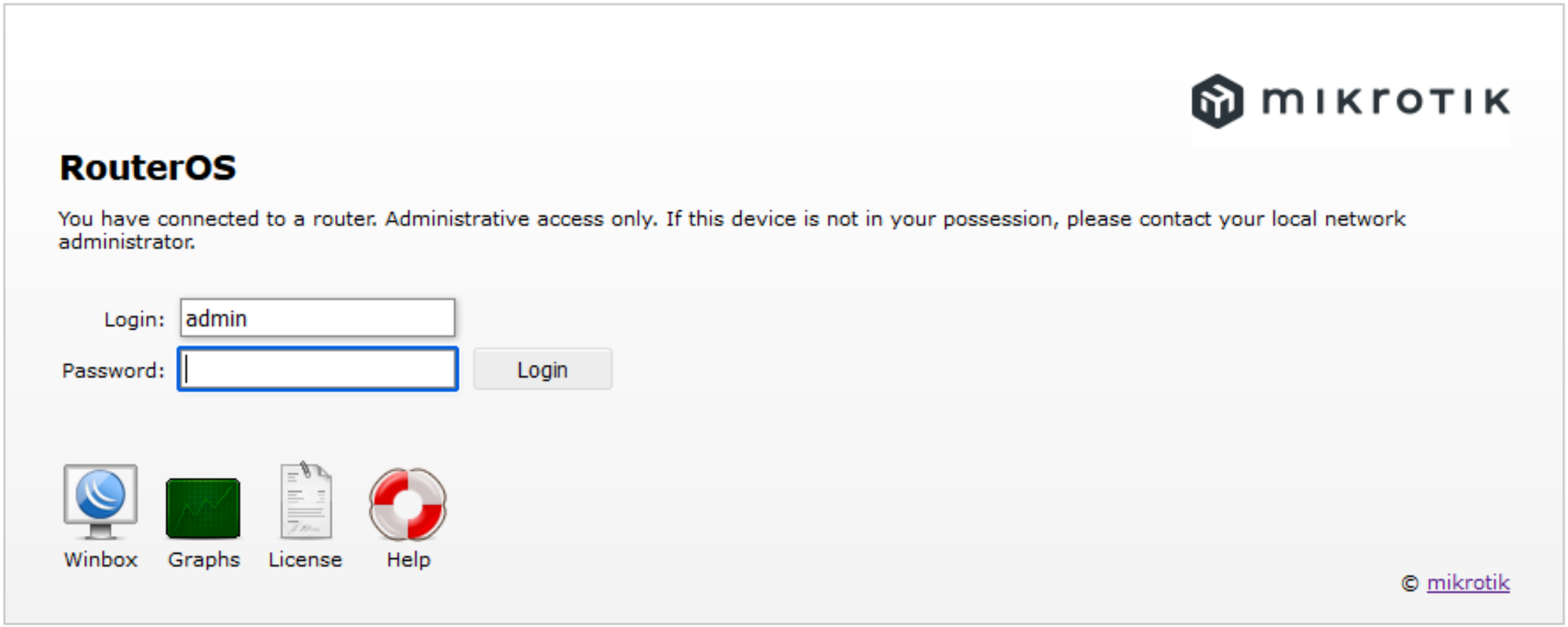
WinBox

- Default IP address (LAN side): 192.168.88.1
- User: admin
- Password: (blank)



WebFig

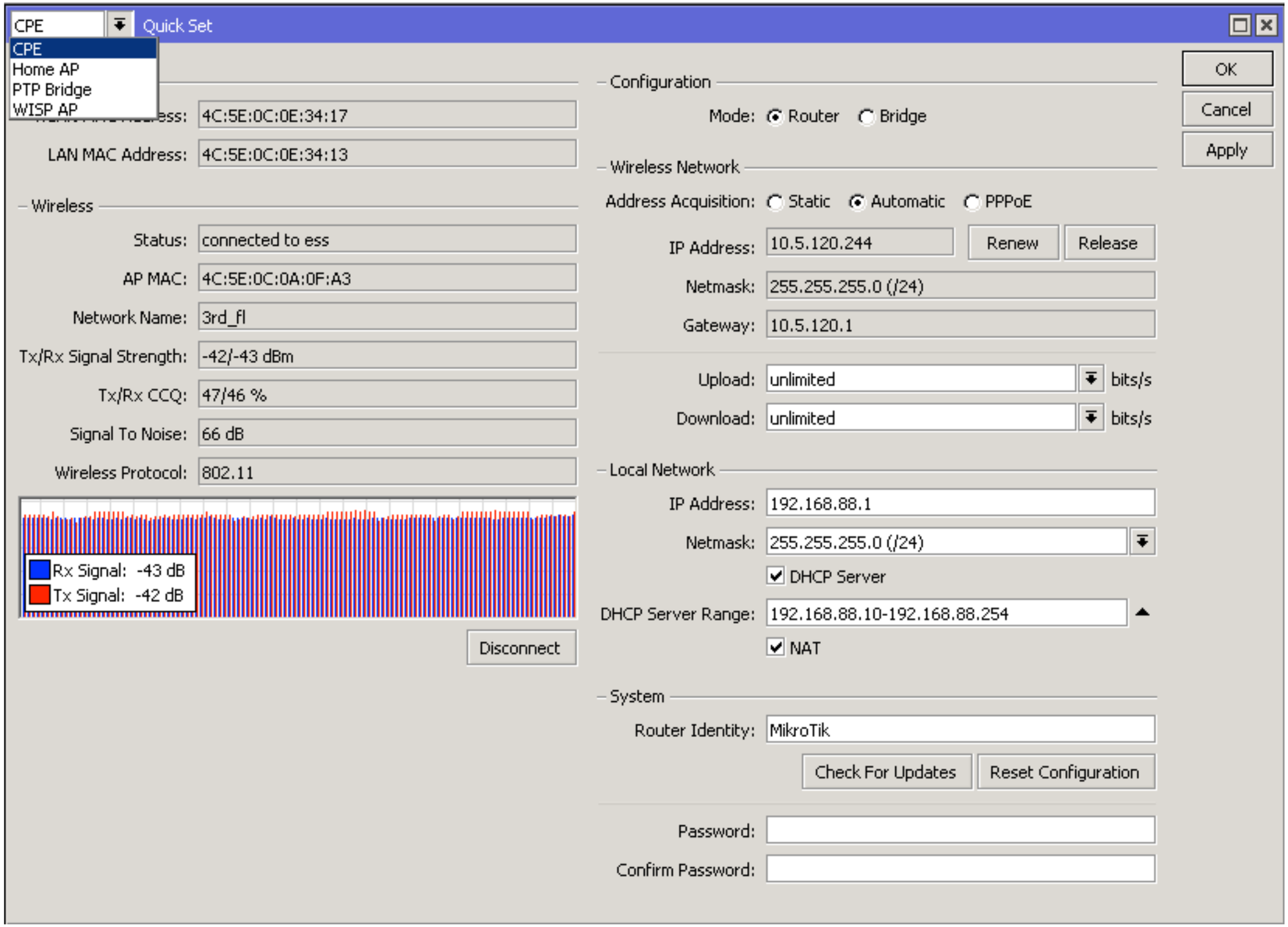
- Browser - http://192.168.88.1



Quick Set

- Basic router configuration in one window
- Accessible from both WinBox and WebFig
- In more detail described in “Introduction to MikroTik RouterOS and RouterBOARDs” course

Quick Set


CPE
Quick Set
CPE
Home AP
PTP Bridge
WISP AP
LAN MAC Address: 4C:5E:0C:0E:34:13
Wireless
Status: connected to ess
AP MAC: 4C:5E:0C:0A:0F:A3
Network Name: 3rd_fl
Tx/Rx Signal Strength: -42/-43 dBm
Tx/Rx CCQ: 47/46 %
Signal To Noise: 66 dB
Wireless Protocol: 802.11
Rx Signal: -43 dB
Tx Signal: -42 dB
Disconnect
Configuration
Mode: Router Bridge
Wireless Network
Address Acquisition: Static Automatic PPPoE
IP Address: 10.5.120.244
Renew
Release
Netmask: 255.255.255.0 (/24)
Gateway: 10.5.120.1
Upload: unlimited bits/s
Download: unlimited bits/s
Local Network
IP Address: 192.168.88.1
Netmask: 255.255.255.0 (/24)
DHCP Server
DHCP Server Range: 192.168.88.10-192.168.88.254
NAT
System
Router Identity: MikroTik
Check For Updates
Reset Configuration
Password:
Confirm Password:
OK
Cancel
Apply

Default Configuration

- Different default configuration applied
- For more info see default configuration support page
- Example: SOHO routers - DHCP client on Ether1, DHCP server on rest of ports + WiFi
- Can be discarded and ‘blank’ used instead

Command Line Interface

- Available via SSH, Telnet or ‘New Terminal’ in WinBox and WebFig

```
MMM       MMM        KKK                                TTTTTTTTTTT       KKK
MMMM     MMMM        KKK                                TTTTTTTTTTT       KKK
MMM MMMM MMM   III   KKK  KKK   RRRRRR      OOOOOO        TTT      III   KKK  KKK
MMM  MM  MMM   III   KKKKK      RRR  RRR   OOO  OOO      TTT      III   KKKKK
MMM      MMM   III   KKK KKK    RRRRRR     OOO  OOO      TTT      III   KKK KKK
MMM      MMM   III   KKK  KKK   RRR  RRR    OOOOOO       TTT      III   KKK  KKK

  MikroTik RouterOS 7.13.4 (c) 1999-2024       https://www.mikrotik.com/

Press F1 for help


Change your password
new password>
repeat new password>
[admin@MikroTik] >
[admin@MikroTik] >
[admin@MikroTik] >
[admin@MikroTik] > ip/address/print
Flags: D - DYNAMIC
Columns: ADDRESS, NETWORK, INTERFACE
#   ADDRESS            NETWORK        INTERFACE
0 D 192.168.56.102/24  192.168.56.0   ether4
[admin@MikroTik] >
```

Command Line Interface

- <tab> completes command
- double <tab> shows available commands
- ‘?’ shows help
- Navigate previous commands with <↑>, <↓> buttons

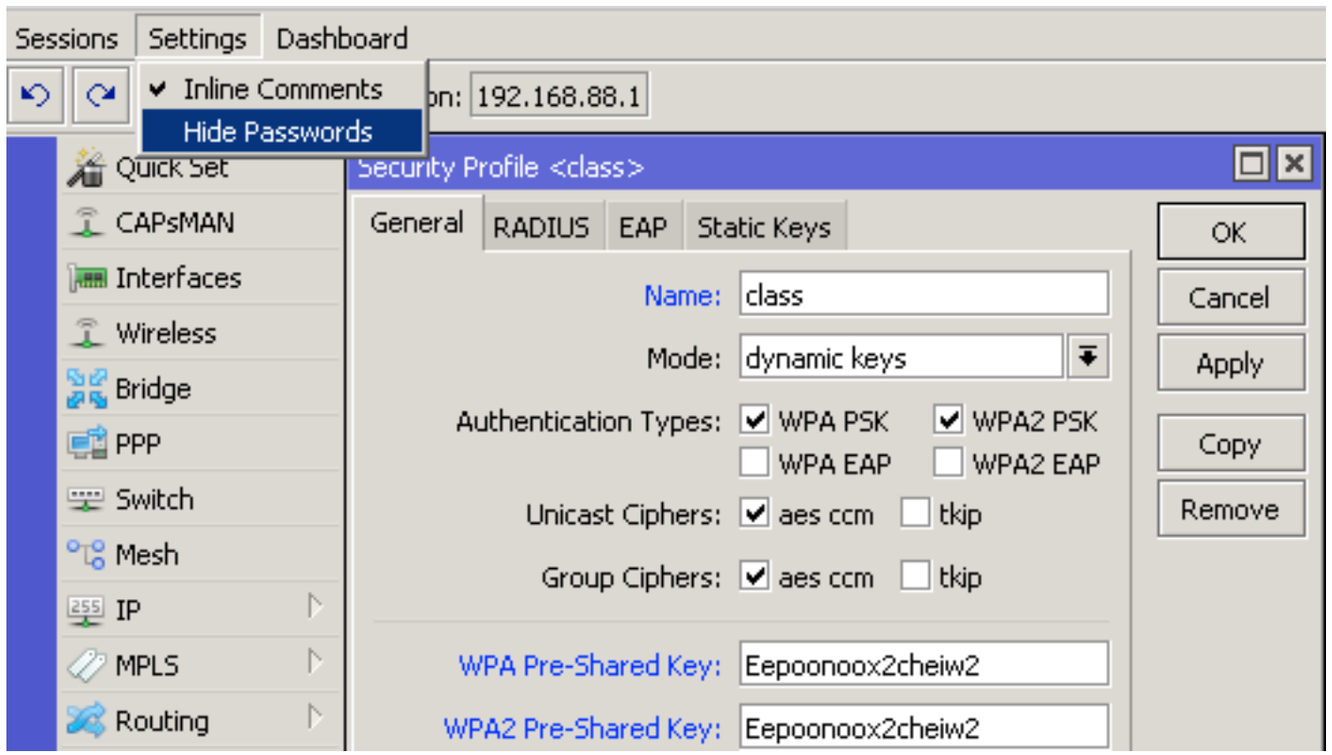
Command Line Interface

- Hierarchical structure (similar to WinBox menu)
- For more info see console support page

```
[admin@MikroTik] > interface/print
Flags: R - RUNNING
Columns: NAME, TYPE, ACTUAL-MTU, MAC-ADDRESS
#    NAME    TYPE    ACTUAL-MTU  MAC-ADDRESS
0 R ether1   ether          1500  08:00:27:C7:2D:F4
1 R ether2   ether          1500  08:00:27:93:44:58
2 R ether3   ether          1500  08:00:27:3F:9A:D1
3 R ether4   ether          1500  08:00:27:E4:4A:38
[admin@MikroTik] >
```

WinBox Tip

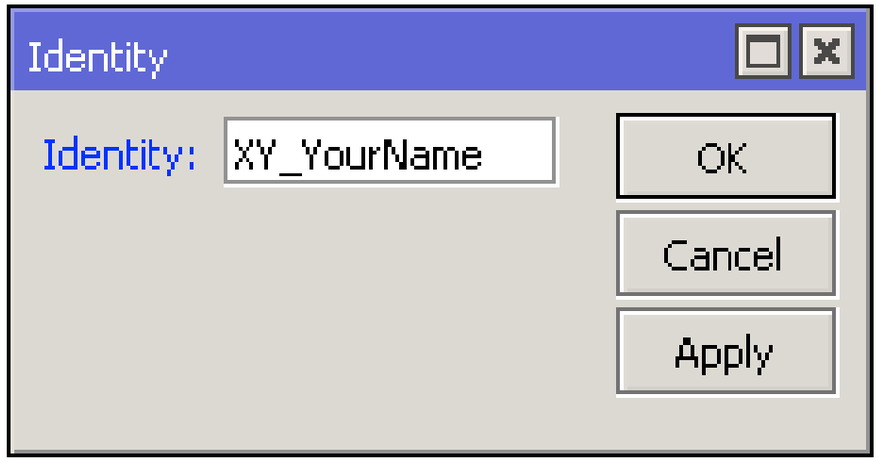
- To view hidden information (except user password), select Settings → Hide Passwords



Wireless → Security Profiles

Router Identity

- Option to set a name for each router
- Identity information available in different places



System → Identity

```
/                       Move up to base level
..                      Move up one level
/command                Use command at the base level
[admin@XY_YourName] >
```

admin@192.168.88.1 (XY_YourName) - WinBox v6.33 on hAP (mipsbe)

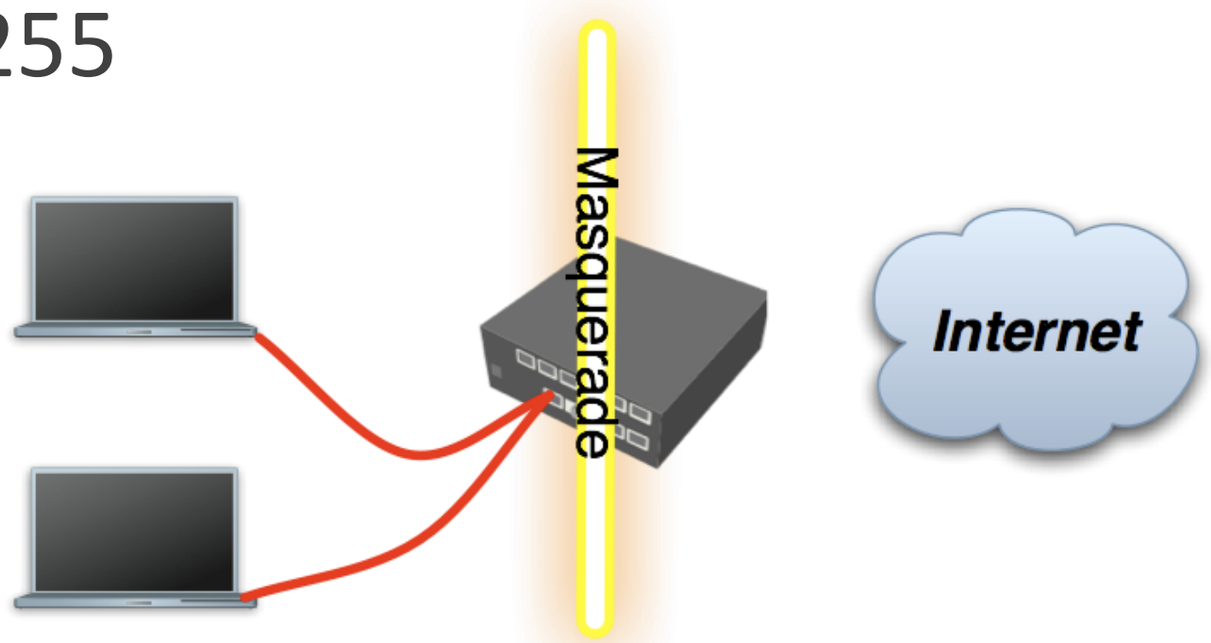
Managed | Neighbors

Refresh

MAC Address	IP Address	Identity	Version	Board
D4:CA:6D:E2:65:90	192.168.88.1	XY_YourName	6.33 (stable)	RB951Ui-2nD

Private and Public Space

- Masquerade is used for Public network access, where private addresses are present
- Private networks include:
  - 10.0.0.0-10.255.255.255
  - 172.16.0.0-172.31.255.255
  - 192.168.0.0-192.168.255.255



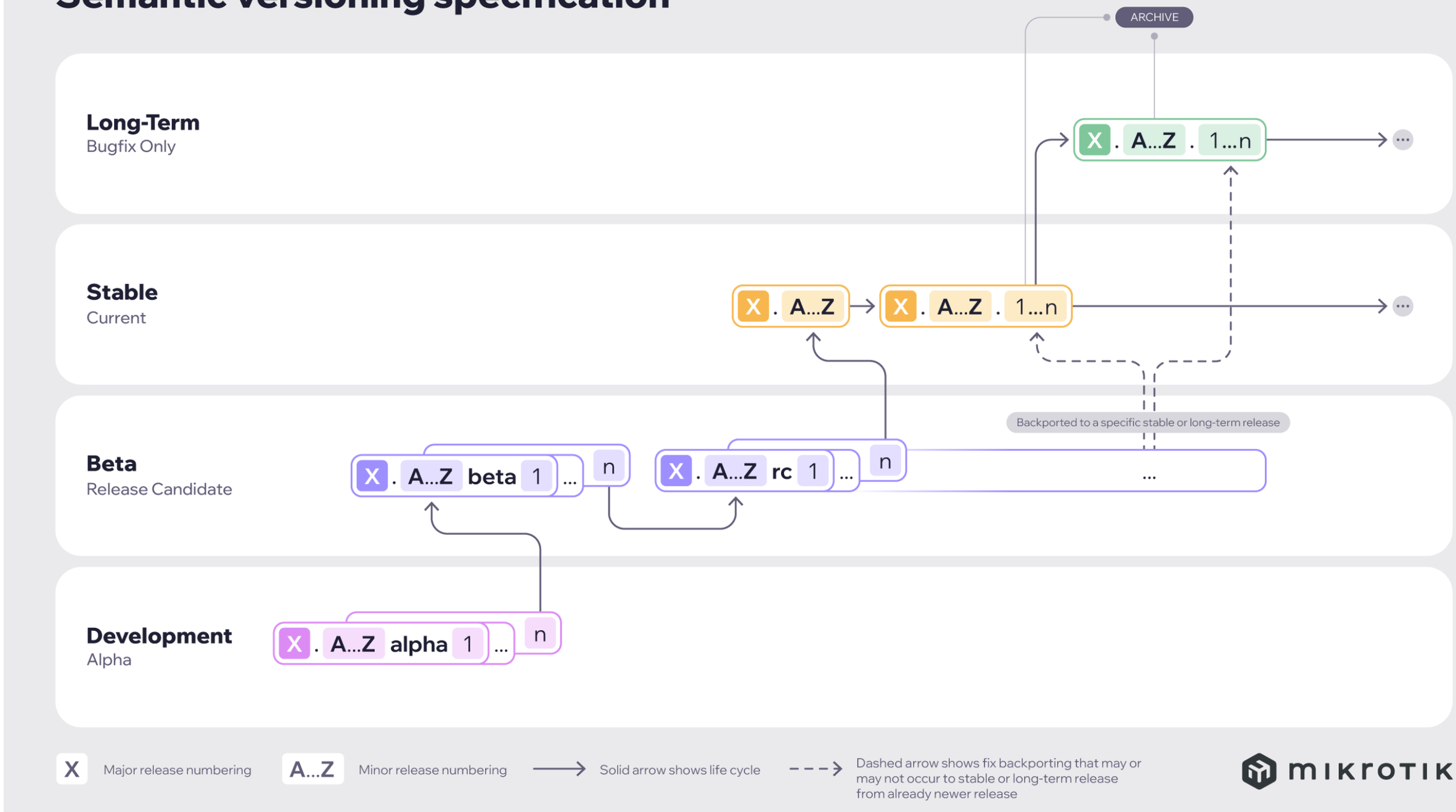
Troubleshooting

- The router cannot ping further than AP
- The router cannot resolve names
- The laptop cannot ping further than the router
- The laptop cannot resolve domain names
- Masquerade rule is not working

Upgrade a instalace balíčků

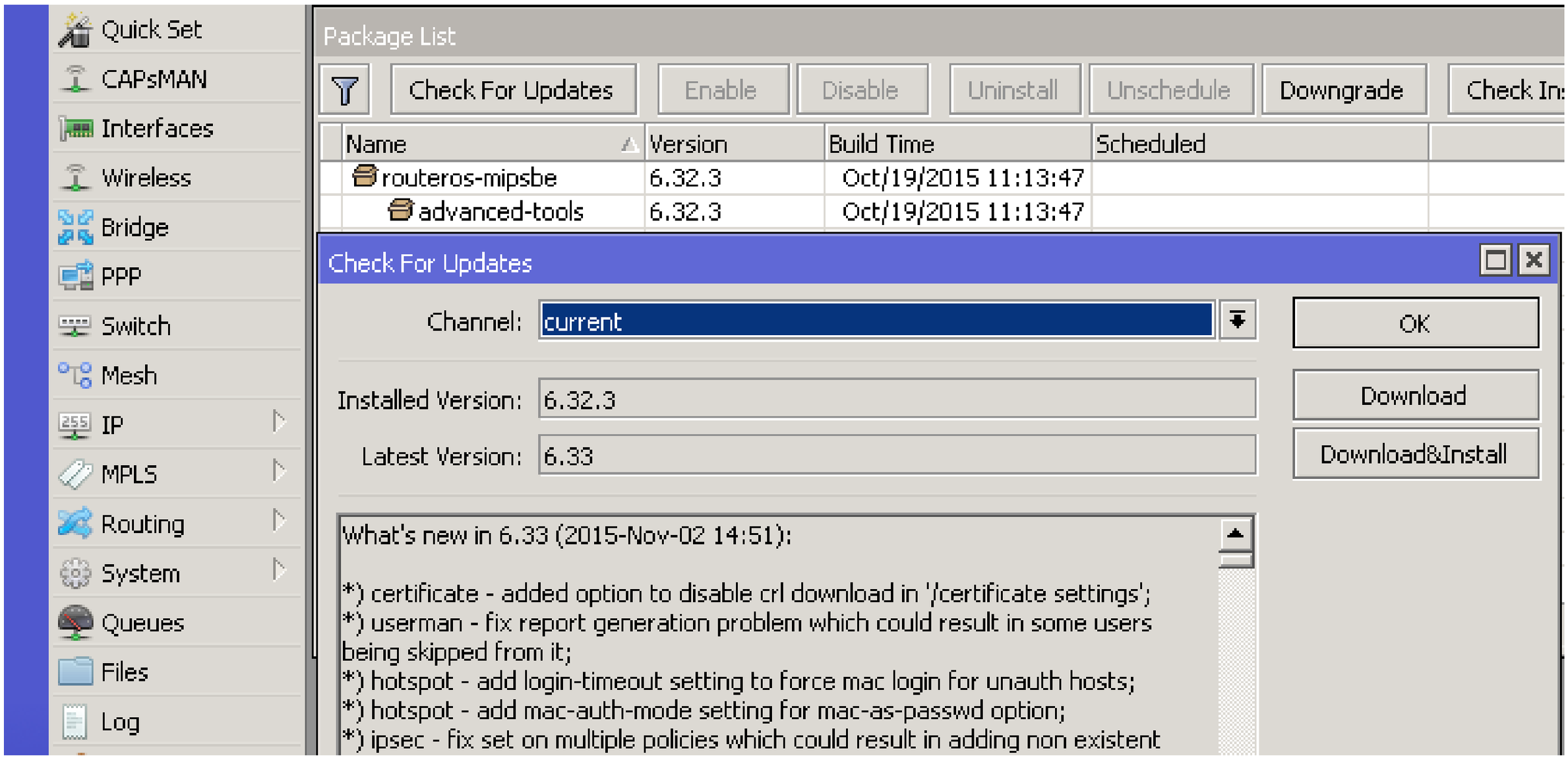
RouterOS Releases

Semantic versioning specification



Upgrading the RouterOS

- The easiest way to upgrade



System → Packages → Check For Updates

Upgrading the RouterOS

- Download the update from www.mikrotik.com/download page
  - Check the architecture of your router's CPU
- Drag&drop into the WinBox window
  - Other ways: WebFig Files menu, FTP, sFTP
- Reboot the router

RouterOS Packages

- Each CPU architecture has a combined package:
  - routeros-arm (arm)
  - routeros-arm (arm64)
  - routeros-mipsbe (mipsbe)
  - routeros-mmips (mmips)
  - routeros-smips (smips)
  - routeros-tile (tile)
  - routeros-ppc (ppc)
  - routeros (x86, CHR)
- Contains all the standard RouterOS features (wireless, dhcp, ppp, routing, etc.)
- Extra packages can be downloaded from www.mikrotik.com/download page

RouterOS Extra Packages

Package	Description
calea	Data gathering tool for specific use due to "Communications Assistance for Law Enforcement Act" in the USA
container	Container implementation of Linux containers, allows users to run containerized environments within RouterOS
dude	Dude tool that allows monitoring of network environment
gps	Global Positioning System devices support
iot	Enables Bluetooth, MQTT, and LoRa functionality
lora	Lora support
lte	Required package only for SXT LTE (RBSXTLTE3-7), which contains drivers for the built-in LTE interface.
rose-storage	Additional enterprise data center functionality in RouterOS
tr069-client	TR069 Client package
ups	APC ups management interface
user-manager	User Manager server for controlling Hotspot and other service users.
zerotier	Enables ZeroTier functionality

RouterOS Wireless Packages

Package	Description
wifiwave2	For 7.12 and older versions: WifiWave2 package for managing compatible 802.11ax and 802.11ac wave 2 wireless interfaces and WifiWave2 CAPsMAN for central WifiWave2 device management. Mandatory for 802.11ax devices.
wifi-qcom	Mandatory driver package for 802.11ax interfaces. Introduced in 7.13. Wifi CAPsMAN support comes with the system package.
wifi-qcom-ac	Optional Wifi driver package for compatible 802.11ac interfaces. Introduced in 7.13.
wireless	Utilities and drivers for managing WiFi (up to 802.11ac) and 60GHz wireless interfaces. This package is bundled into RouterOS for versions up to 7.12. Starting with 7.13, it is a separate package. The **wireless** package conflicts with **wifi-qcom** and **wifi-qcom-ac** packages - they cannot be active at the same time.

Downgrading Packages

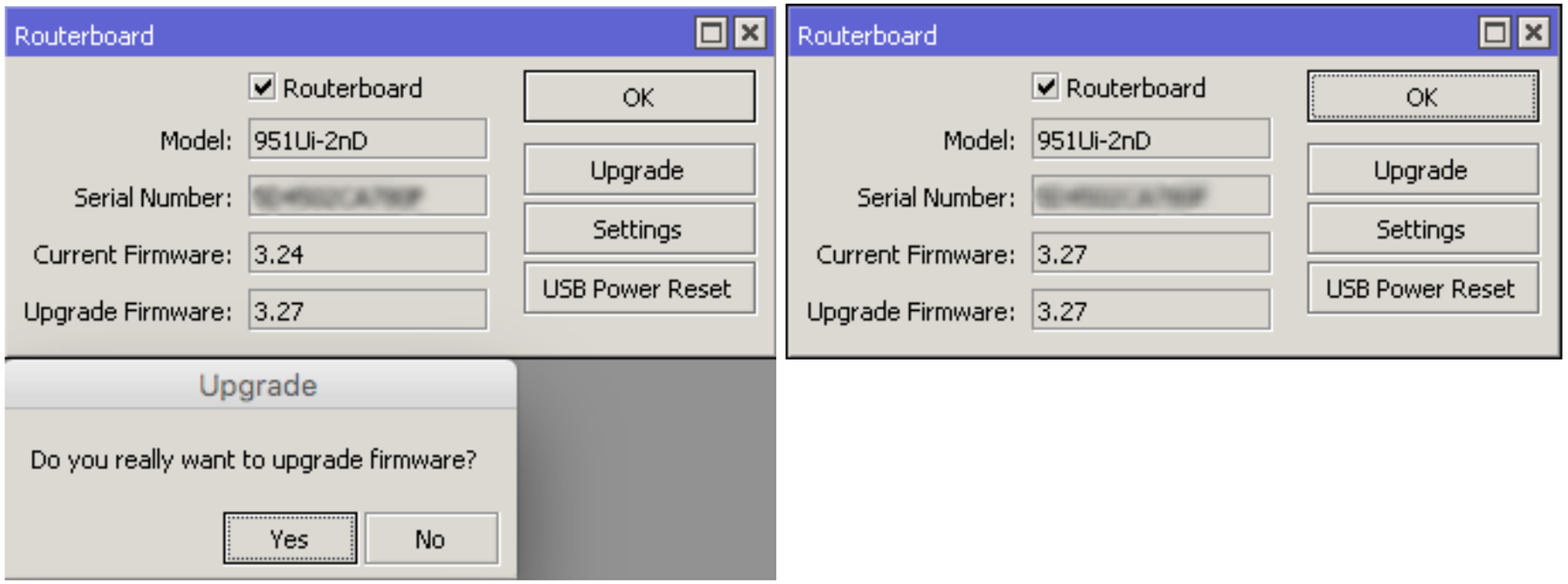
- From System → Packages menu
- ‘Check For Updates’ and choose different Channel (e.g. bugfix-only)
- Click ‘Download’
- Click ‘Downgrade’ in ‘Package List’ window

RouterBOOT

- Firmware responsible for starting RouterOS on RouterBOARD devices
- Two boot loaders on RouterBOARD - main and backup
- Main can be updated
- Backup loader can be loaded if needed

RouterBOOT

- For more info see RouterBOOT support page



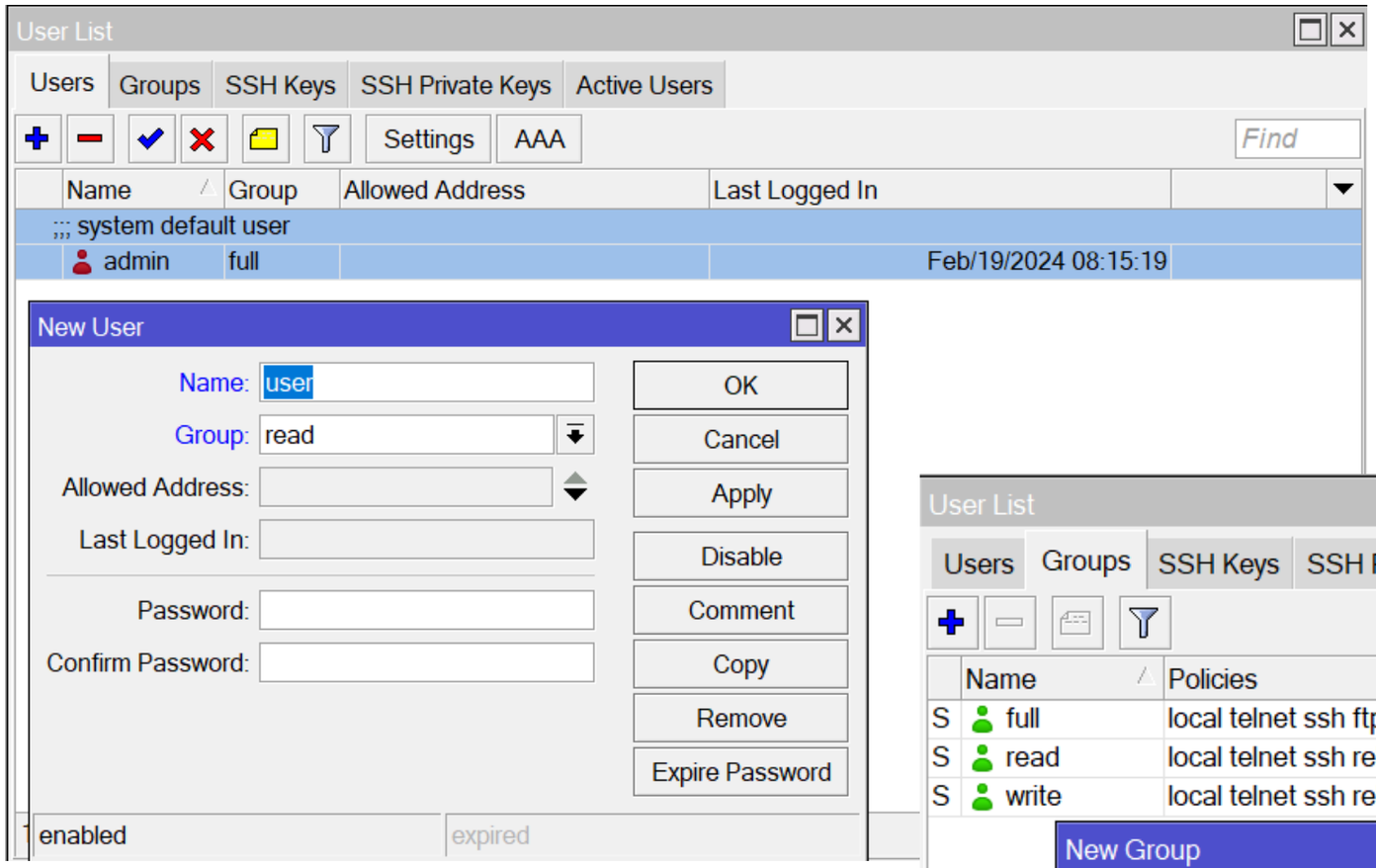
System → Routerboard

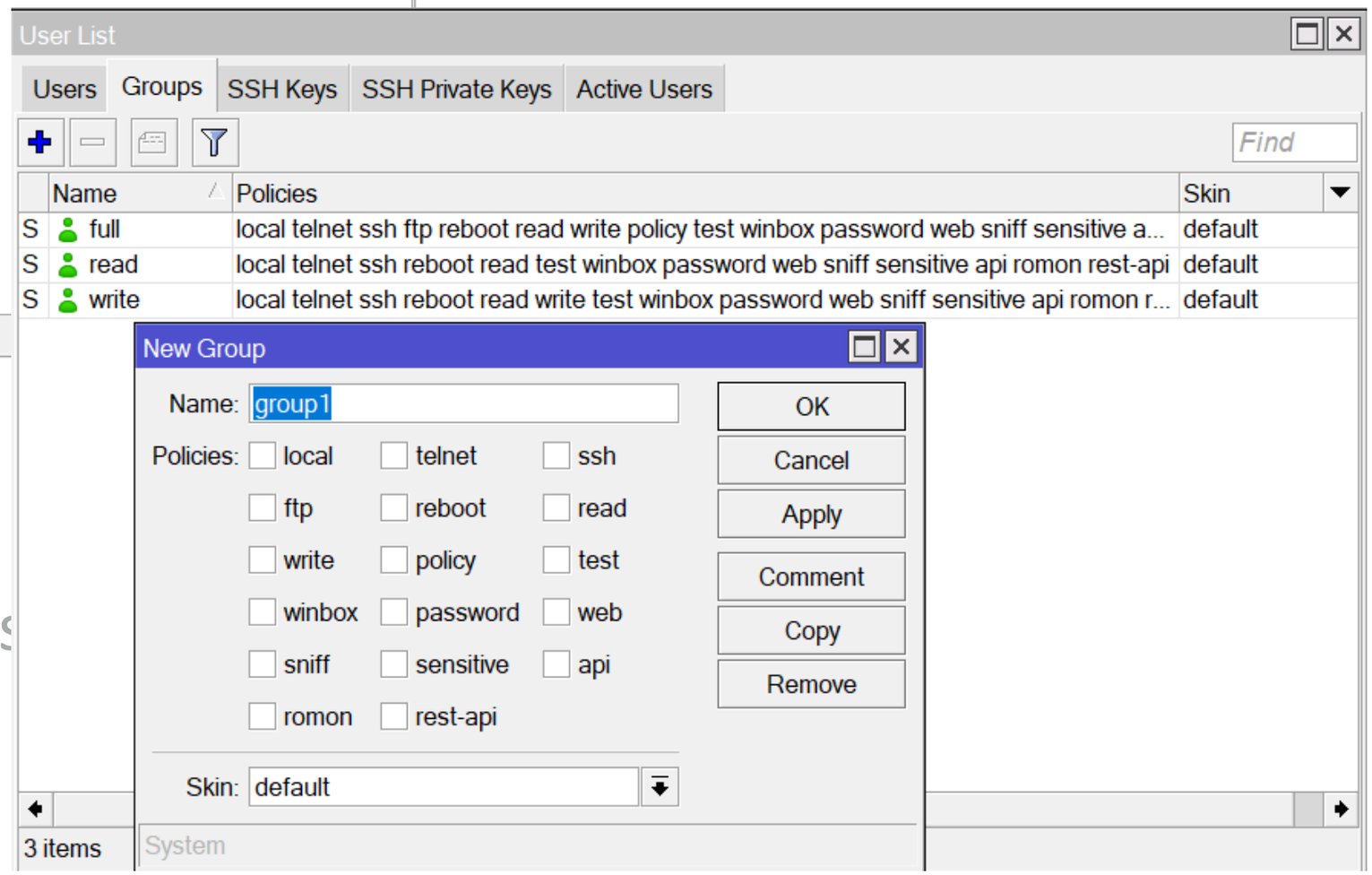
Správa uživatelů

RouterOS Users

- Default user admin, group full
- Additional groups - read and write
- Can create your own group and fine tune access

RouterOS Users





Služby pro přístup na zařízení

RouterOS Services

- Different ways to connect to the RouterOS
- Disable services which are not used
- Restrict access with ‘available from’ field
- Default ports can be changed

IP Service List

Find

	Name	Port	Available From	VRF	Certificate	TLS Vers..
	api	8728		main		
	api-ssl	8729		main	none	any
	ftp	21				
	ssh	22		main		
	telnet	23		main		
	winbox	8291		main		
	www	80		main		
X	www-ssl	443		main	none	any

8 items

IP → Services

RouterOS Services

- API - Application Programming Interface
- FTP - for uploading/downloading files to/from the RouterOS
- SSH - secure command line interface
- Telnet - insecure command line interface
- WinBox - GUI access
- WWW - access from the web browser

Záloha konfigurace

Configuration Backup

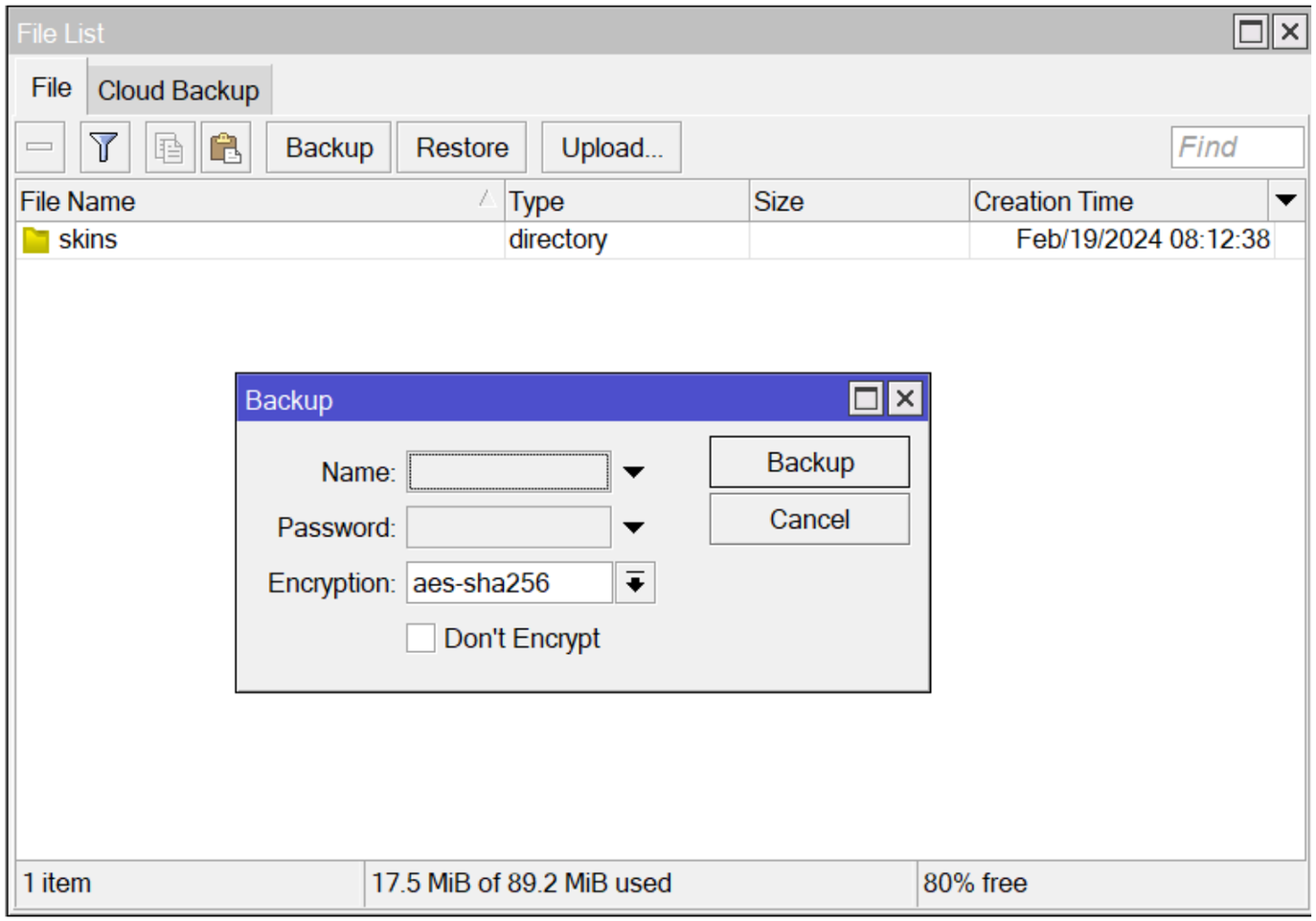
- Two types of backups
- Backup (.backup) file - used for restoring configuration on the same router
- Export (.rsc) file - used for moving configuration to another router

Configuration Backup

- Backup file can be created and restored under Files menu in WinBox
- Backup file is binary, by default encrypted with user password. Contains a full router configuration (passwords, keys, etc.)

Configuration Backup

- Custom name and password can be entered
- Router identity and current date is used as a backup file name



Configuration Backup

- Export (.rsc) file is a script with which router configuration can be backed up and restored
- Plain-text file (editable)
- Contains only configuration that is different than the factory default configuration

Configuration Backup

- Export file is created using ‘export’ command in CLI
- Whole or partial router configuration can be saved to an export file
- RouterOS user passwords are not saved when using export

Configuration Backup

- Store files in ‘flash’ folder
- Contains ready to use RouterOS commands

```
[admin@XY_YourName] > /export file=flash/router_conf_20151106
[admin@XY_YourName] > /file print
 # NAME                                  TYPE                                SIZE CREATION-TIME
 0 flash                                 disk                                     jan/01/1970 02:00:00
 1 flash/skins                           directory                                jan/01/1970 02:00:01
 2 flash/XY_YourName-20151106-0939.backup  backup                           37.6KiB nov/06/2015 09:39:10
 3 flash/router_conf_20151106.rsc        script                              3595 nov/06/2015 09:40:35
[admin@XY_YourName] >
```

```
[admin@XY_YourName] > /export
# nov/06/2015 09:46:57 by RouterOS 6.33
# software id = 85WZ-DDQS
#
/interface bridge
add admin-mac=D4:CA:6D:E2:65:90 auto-mac=no name=bridge-local
/interface ethernet
set [ find default-name=ether1 ] name=ether1-gateway
set [ find default-name=ether2 ] name=ether2-master-local
set [ find default-name=ether3 ] master-port=ether2-master-local name=ether3-slave-local
set [ find default-name=ether4 ] master-port=ether2-master-local name=ether4-slave-local
set [ find default-name=ether5 ] master-port=ether2-master-local name=ether5-slave-local
/ip neighbor discovery
set ether1-gateway discover=no
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
add authentication-types=wpa-psk,wpa2-psk eap-methods="" management-protection=allowed mode=dynamic-keys name=\
    class supplicant-identity="" wpa-pre-shared-key=baelezaicei3leiM wpa2-pre-shared-key=baelezaicei3leiM
```

Configuration Backup

- Export file can be edited by hand
- Can be used to move configuration to a different RouterBOARD
- Restore using ‘/import’ command

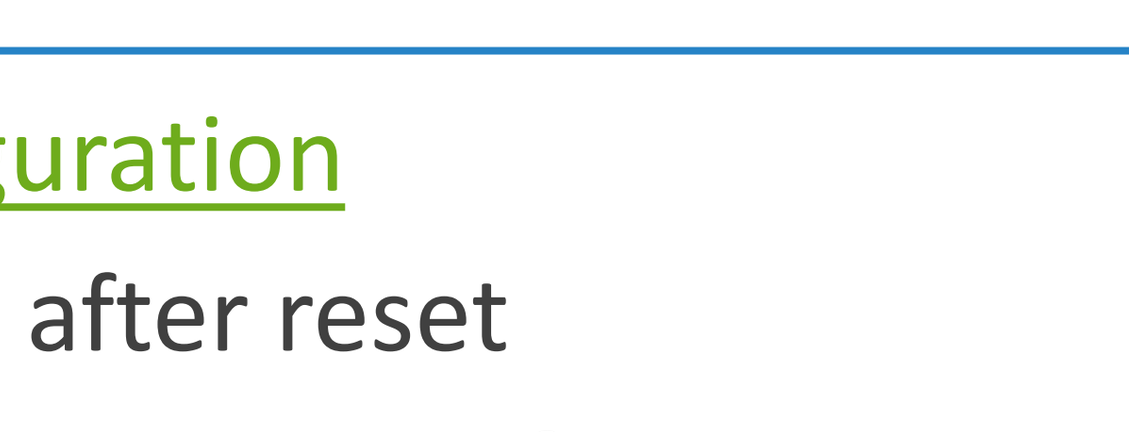
```
[admin@XY_YourName] > /import flash/router_conf_20151106.rsc

Script file loaded and executed successfully
[admin@XY_YourName] >
```

Configuration Backup

- Download to a computer using WinBox (drag&drop), FTP or WebFig
- Don’t store the copy of the backup only on the router! It is not a good backup strategy!

Reset Configuration

- Reset to default configuration
- Retain RouterOS users after reset
- Reset to a router without any configuration (‘blank’)
- Run a script after reset



System → Reset Configuration

Reset Configuration

- Using physical ‘reset’ button on the router
  - Load backup RouterBOOT loader
  - Reset router configuration
  - Enable CAPs mode (Controlled AP)
  - Start in Netinstall mode

- For more info see reset button support page

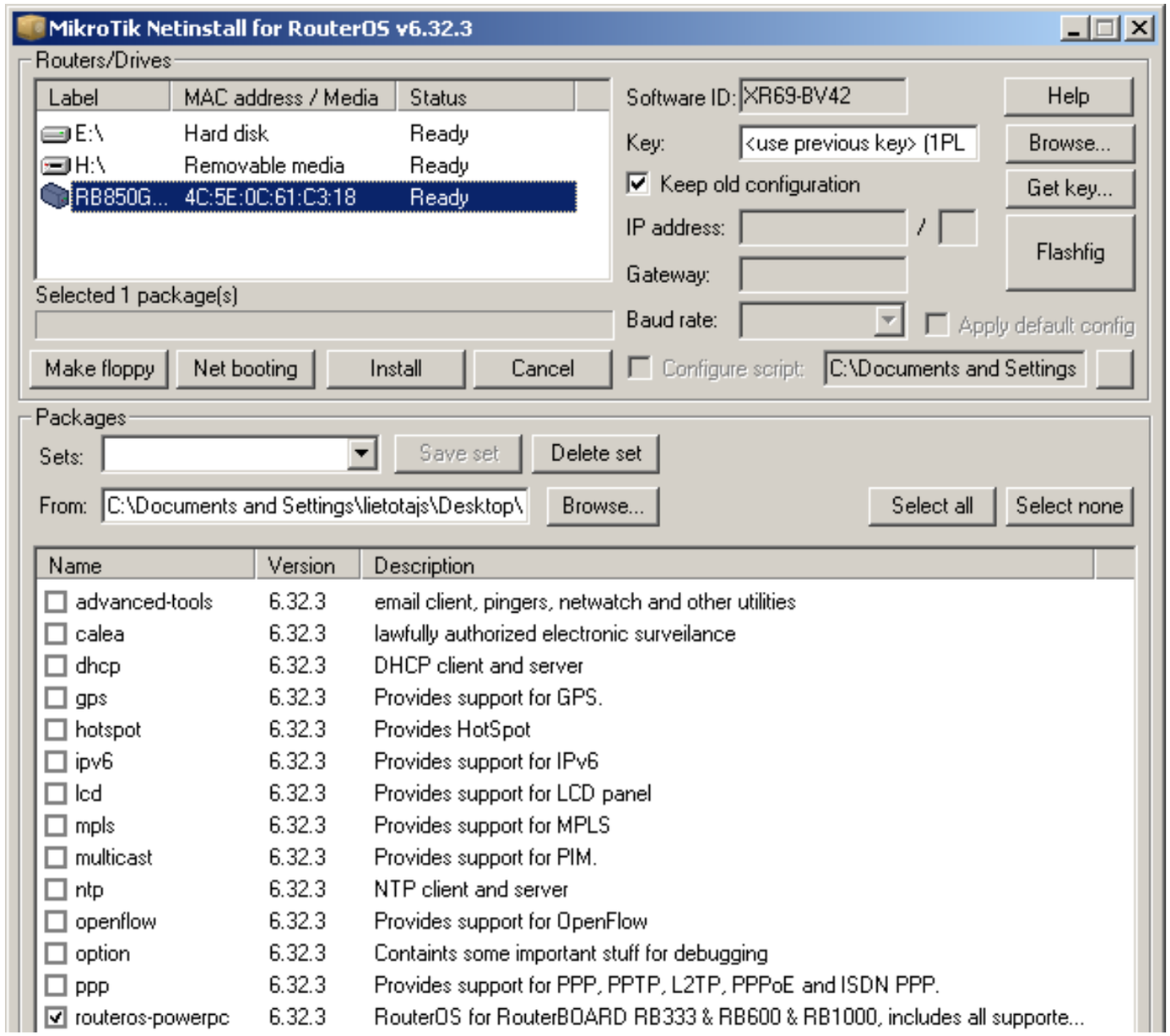
Netinstall

Netinstall

- Used for installing and reinstalling RouterOS
- Direct network connection to the router is required (can be used over switched LAN)
- Cable must be connected to Ether1 port (except CCR and RB1xxx - last port)
- Runs on Windows
- For more info see Netinstall wiki page

Netinstall

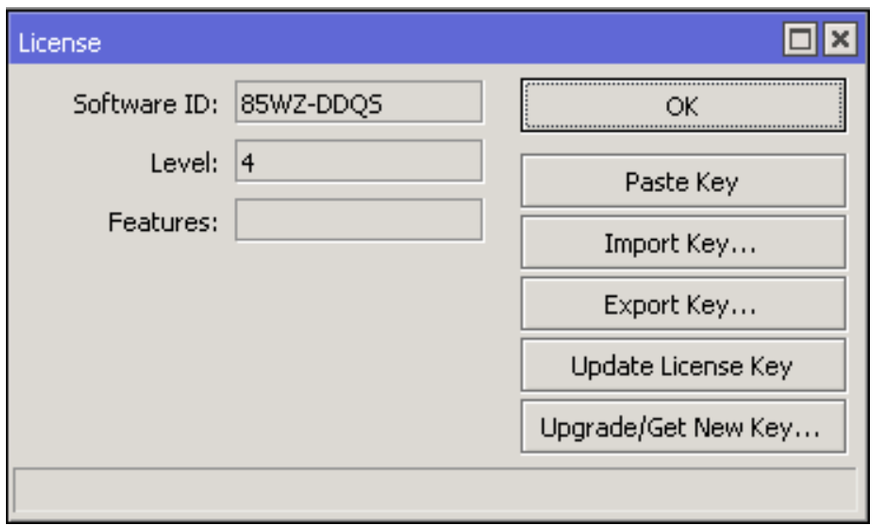
- Available at www.mikrotik.com/download



Licence

RouterOS License

- All RouterBOARDs are shipped with a license
- Different license levels (features)
- RouterOS updates for life
- x86 license can be purchased from www.mikrotik.com or distributors



System → License

RouterOS License

Level	Type	Typical Use
0	Trial Mode	24h trial
1	Free Demo	
3	CPE	Wireless client (station), volume only
4	AP	Wireless AP: WISP, HOME, Office
5	ISP	Supports more tunnels than L4
6	Controller	Unlimited RouterOS features

RouterOS License

Level number	0 (trial mode)	1 (Free demo)	3 (CPE)	4 (WISP)	5 (WISP)	6 (Controller)
Price	**no key**	**registration required**	not for sale	$45	$95	$250
Wireless AP mode (PtMP)	24h trial	-	no	yes	yes	yes
PPPoE tunnels	24h trial	1	200	200	500	unlimited
PPTP tunnels	24h trial	1	200	200	500	unlimited
L2TP tunnels	24h trial	1	200	200	500	unlimited
OVPN tunnels	24h trial	1	200	200	unlimited	unlimited
EoIP tunnels	24h trial	1	unlimited	unlimited	unlimited	unlimited
VLAN interfaces	24h trial	1	unlimited	unlimited	unlimited	unlimited
Queue rules	24h trial	1	unlimited	unlimited	unlimited	unlimited
HotSpot active users	24h trial	1	1	200	500	unlimited
User manager active sessions	24h trial	1	10	20	50	Unlimited
Bonding interfaces	24h trial	1	unlimited	unlimited	unlimited	unlimited

CHR Licences

License	Speed limit	Price	Description
Free	1Mbit	FREE	• limited to 1Mbps upload per interface • all the rest of the features are without restrictions
P1	1Gbit	$45	• limited to 1Gbps upload per interface • all the rest of the features are without restrictions
P10	10Gbit	$95	• limited to 10Gbps upload per interface • all the rest of the features are without restrictions
P-Unlimited	Unlimited	$250	• allows CHR to run indefinitely • it is the highest tier license and it has no enforced limitations
60-day Trial		FREE	• To test the increased speed of P1/P10/PU licenses • you will need an account registered on MikroTik.com • a trial period is 60 days from the day of acquisition • run the command "/system license renew" and put the username and password of your mikrotik.com account

Additional Information

- help.mikrotik.com
  - RouterOS documentation and examples
- wiki.mikrotik.com
  - RouterOS documentation and examples (old)
- forum.mikrotik.com
  - communicate with other RouterOS users
- mum.mikrotik.com
  - MikroTik User Meeting page
- support@mikrotik.com
  - Distributor and consultant support

Otázky