



WiFi lab časť 2/3

Nastavenie ďalších vybraných funkcionalít AP

KIS FRI UNIZA

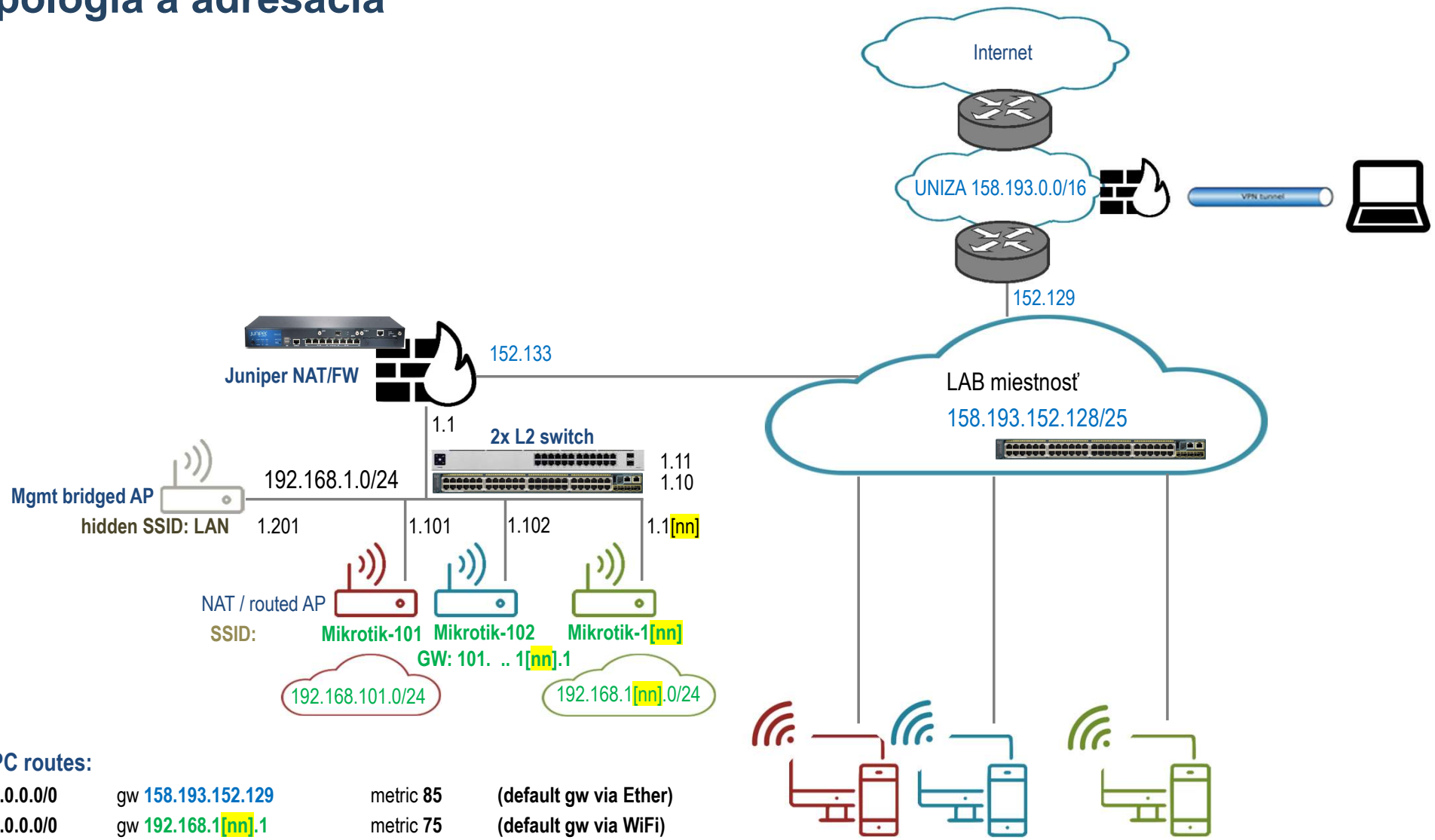


Vytvorené v rámci projektu **KEGA 026TUKE-4/2021**

Agenda

- Wireless nastavenia
- WPS
- IP FW
- Hotspot

Topológia a adresácia



PC routes:

0.0.0.0/0	gw 158.193.152.129	metric 85	(default gw via Ether)
0.0.0.0/0	gw 192.168.1[nn].1	metric 75	(default gw via WiFi)
158.193.0.0/16	gw 158.193.152.129	metric 25	(UNIZA net)

Adresácia a skupiny

Skupina											
a	Model	Meno	S/N	Wlan MAC	Ether MAC	SSID	WPA2 Pre-shared Key	NET	uplink	login	pass
1	411UAHR	Mikrotik 1	24D10199373A	00:0C:42:44:6F:8E	00:0C:42:44:6F:8D	Mikrotik-101	!234567*	192.168.101.1/24	192.168.1.101	admin	k!s143
2	411UAHR	Mikrotik 2	24D1019445AE	00:0C:42:49:1D:1A	00:0C:42:49:1D:19	Mikrotik-102	!234567*	192.168.102.1/24	192.168.1.102	admin	k!s143
3	411UAHR	Mikrotik 3	24D101944462	00:0C:42:49:1C:D6	00:0C:42:49:1C:D5	Mikrotik-103	!234567*	192.168.103.1/24	192.168.1.103	admin	k!s143
4	411UAHR	Mikrotik 4	24D1019445BE	00:0C:42:49:1D:0A	00:0C:42:49:1D:09	Mikrotik-104	!234567*	192.168.104.1/24	192.168.1.104	admin	k!s143
5	411UAHR	Mikrotik 5	24D10199371A	00:0C:42:44:6F:AE	00:0C:42:44:6F:AD	Mikrotik-105	!234567*	192.168.105.1/24	192.168.1.105	admin	k!s143
6	411UAHR	Mikrotik 6	24D1019445B4	00:0C:42:49:1D:04	00:0C:42:49:1D:03	Mikrotik-106	!234567*	192.168.106.1/24	192.168.1.106	admin	k!s143
7	411UAHR	Mikrotik 7	24D10194447C	00:0C:42:49:1C:CC	00:0C:42:49:1C:CB	Mikrotik-107	!234567*	192.168.107.1/24	192.168.1.107	admin	k!s143
8	411UAHR	Mikrotik 8	24D10199372A	00:0C:42:44:6F:9E	00:0C:42:44:6F:9D	Mikrotik-108	!234567*	192.168.108.1/24	192.168.1.108	admin	k!s143
9	411UAHR	Mikrotik 9	24D10194442A	00:0C:42:49:1C:9E	00:0C:42:49:1C:9D	Mikrotik-109	!234567*	192.168.109.1/24	192.168.1.109	admin	k!s143
10	411UAHR	Mikrotik 10	24D101993724	00:0C:42:44:6F:94	00:0C:42:44:6F:93	Mikrotik-110	!234567*	192.168.110.1/24	192.168.1.110	admin	k!s143
11	RB952Ui-5ac2nD	Mikrotik 11	CC3E0EDD4C25	2C:C8:1B:4C:F9:B6	2C:C8:1B:4C:F9:B0	Mikrotik-111	!234567*	192.168.111.1/24	192.168.1.111	admin	k!s143
12	RB952Ui-5ac2nD	Mikrotik 12	CC3E0E60402C	2C:C8:1B:4C:B0:40	2C:C8:1B:4C:B0:3A	Mikrotik-112	!234567*	192.168.112.1/24	192.168.1.112	admin	k!s143
13	RB952Ui-5ac2nD	Mikrotik 13	CC3E0E52B863	2C:C8:1B:4C:D3:E7	2C:C8:1B:4C:D3:E1	Mikrotik-113	!234567*	192.168.113.1/24	192.168.1.113	admin	k!s143
14	RB952Ui-5ac2nD	Mikrotik 14	CC3E0E83DB79	2C:C8:1B:25:F2:3A	2C:C8:1B:25:F2:34	Mikrotik-114	!234567*	192.168.114.1/24	192.168.1.114	admin	k!s143
15	RB952Ui-5ac2nD	Mikrotik 15	CC3E0EC59727	2C:C8:1B:26:04:26	2C:C8:1B:26:04:20	Mikrotik-115	!234567*	192.168.114.1/24	192.168.1.114	admin	k!s143

Prístupy

PC:

1.) Lokálny prístup alebo 2.) Remote Desktop Connection app - mstsc.exe (resp. iný program na vzdialené ovládanie počítača)

login/pass: RB03-[čísloPC]\student / student

Mikrotik (v default móde):

default login/pass: admin / <blank>

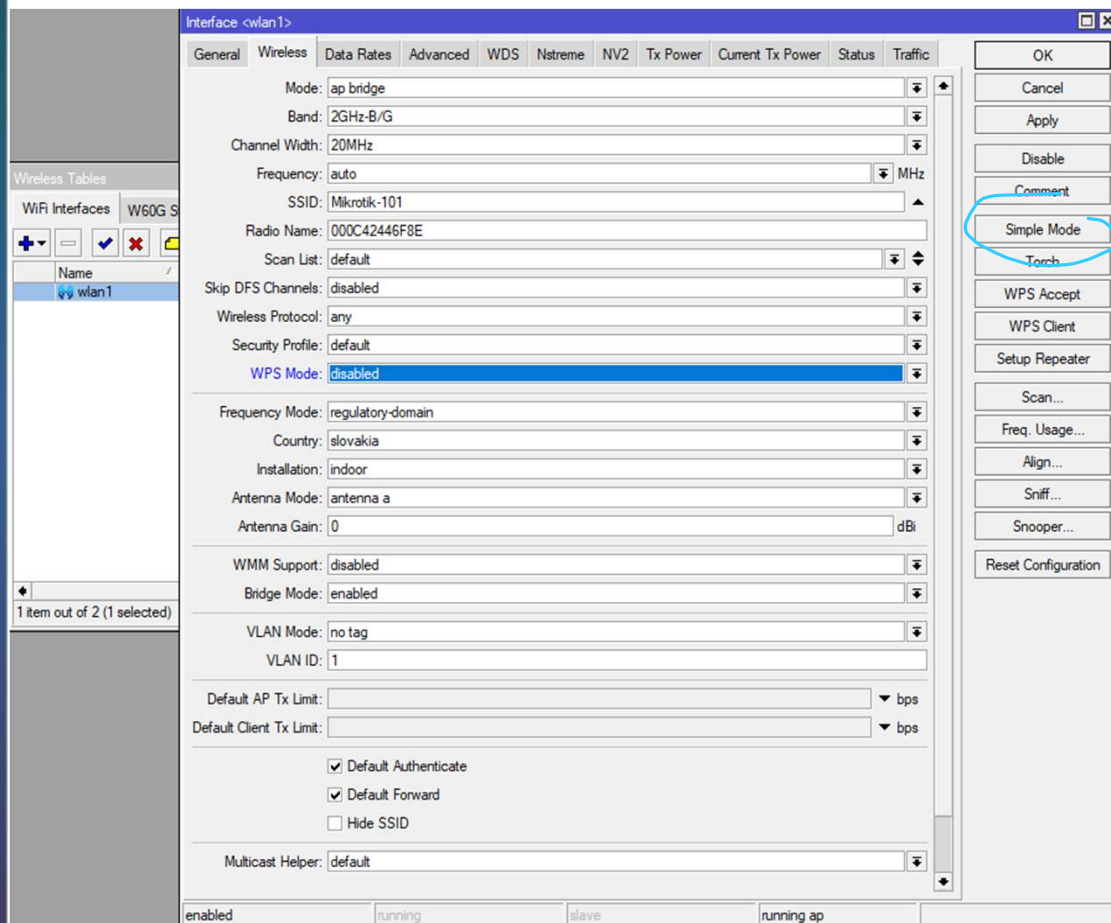
default net: 192.168.88.1/24, alebo 0.0.0.0/0

prístup cez program Winbox a MAC adresu



AP konfigurácia

Wireless nastavenia - Advanced Mode



Mode: Zariadenie môže pracovať v rôznych módoch; Client – Station, p2multipoint Access Point – AP bridge, p2p bridge - bridge

Band and Channel width: frekvenčné pásmo 2GHz b/g/n alebo 5GHz A/N/AC ; šírka kanála určuje veľkosť dostupného kanála na prenos dát. Širšie kanály sú rýchlejšie, no náchylnejšie na rušenie.

Frequency: zvyčajne "Auto" – router otestuje prostredie a zvolí si najmenej používaný alebo rušený komunikačný kanál

Frequency Mode: EU (ETSI) 2.4 GHz: max 20 dBm (100mW) ; EU (ETSI) 5 G GHz: max 26 dBm

Antenna mode: "antenna a" používaj iba anténu a ; "rx-tx" – a Rx / b Tx

WPS: Wi-Fi Protected Setup ; zjednodušenie pripojenia zariadení k sieti Wi-Fi. S protokolom WPS môžete pripojiť zariadenia k smerovaču Wi-Fi bez nutnosti zadávania hesla z bezdrôtovej siete

<https://wiki.mikrotik.com/wiki/Manual:Interface/Wireless>

[https://en.wikipedia.org/wiki/List_of_WLAN_channels#2.4_GHz_\(802.11b/g/n/ax\)](https://en.wikipedia.org/wiki/List_of_WLAN_channels#2.4_GHz_(802.11b/g/n/ax))

Zisk antény

Interface <wlan1>

General Wireless Data Rates Advanced WDS Nstreme NV2 Tx Power **Current Tx Power** Status Traffic

Mode: ap bridge

Band: 2GHz-B/G

Channel Width: 20MHz

Frequency: auto MHz

SSID: Mikrotik-101

Radio Name: 000C42446F8E

Scan List: default

Skip DFS Channels: disabled

Wireless Protocol: any

Security Profile: default

WPS Mode: disabled

Frequency Mode: regulatory-domain

Country: slovakia

Installation: indoor

Antenna Mode: antenna a

Antenna Gain: 2 dBi

WMM Support: disabled

Bridge Mode: enabled

VLAN Mode: no tag

VLAN ID: 1

Default AP Tx Limit: bps

Default Client Tx Limit: bps

Default Authenticate

Default Forward

Hide SSID

Multicast Helper: default

OK Cancel Apply Disable Comment Simple Mode Torch WPS Accept WPS Client Setup Repeater Scan... Freq. Usage... Align... Sniff... Snooper... Reset Configuration

enabled running slave running ap

Antenna gain: Anténa nezosilňuje signál ale môže smerovať energiu v určitom smere. Izotropická (všesmerová) anténa smeruje signál do všetkých smerov, preto má zisk 0dBi v každom smere. Prútová anténa má zvyčajne zisk 2dBi v horizontálnom smere a na všetky smery.

Zvýšenie hodnoty zisku zníži celkový vyžarovací výkon, aby nebola v žiadnom smere prekročená regulovaná hodnota vyžarovacieho výkonu

https://mikrotik.com/test_link.php

Interface <wlan1>

General Wireless Data Rates Advanced WDS Nstreme NV2 Tx Power **Current Tx Power**

- Current Tx Powers -

Rate	Tx Power	Total Tx ...
1Mbps	18dBm	18dBm
2Mbps	18dBm	18dBm
5.5Mbps	18dBm	18dBm
11Mbps	18dBm	18dBm
6Mbps	18dBm	18dBm
9Mbps	18dBm	18dBm
12Mbps	18dBm	18dBm
18Mbps	18dBm	18dBm
24Mbps	18dBm	18dBm
36Mbps	18dBm	18dBm
48Mbps	16dBm	16dBm
54Mbps	15dBm	15dBm

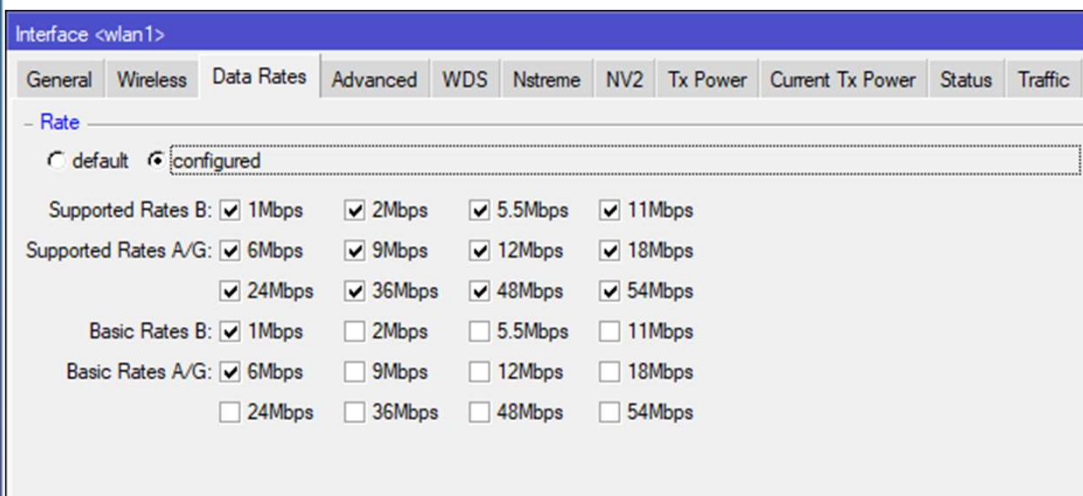
Maximum Transmission Power in EU (ETSI)

2.4 GHz – Two limits, one for 802.11b rates with CCK modulation (1, 2, 5.5 and 11 Mbps) and one for 802.11g/n rates with OFDM modulation. The limit is set to 20 dBm (100 mW) for OFDM and 18 dBm (63 mW) for CCK.

Data rates ; modulačné kódovacie schémy a závislosť prenosovej rýchlosti od kvality signálu

Data Rates: Maximálna teoretická prenosová rýchlosť je určená:

- Zvoleným wireless protokolom 802.11a/b/g/n/ac/ax <https://www.actiontec.com/wifihelp/evolution-wi-fi-standards-look-802-11abgnac/>
- Počtom paralelných kanálov “streams”, ak je podporované ; zavedené v 802.11n (Wi-Fi 4) štandarde
- Moduláciou a kódovacou schémou (MCS) – AP a klient zvolí na základe kvality signálu
- Predkonfigurovanou šírkou prenosového kanálu



802.11b - DSSS modulácia s CCK alebo PBCC modulačnými kódovacími schémami (MCS). Resp. DQPSK alebo DBPSK kódovanie pre pomalé rýchlosti 1-2Mbps

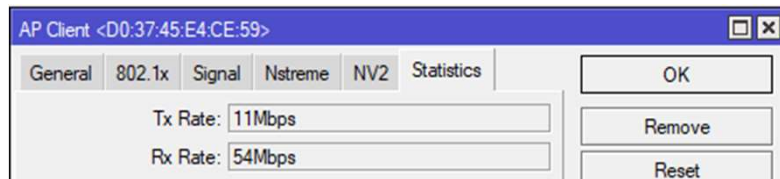
802.11g zvyčajne používa OFDM moduláciu s 16/64-QAM kódovaním

https://wiki.mikrotik.com/wiki/Manual:Interface/Wireless#Basic_and_MCS_Rate_table

	802.11 (Legacy)	802.11b (Legacy)	802.11a (Legacy)	802.11g (Legacy)	802.11n (HT)	802.11ac (VHT)	802.11ax (HE)
Year Ratified	1997	1999	1999	2003	2009	2014	2019 (Expected)
Operating Band	2.4 GHz/IR	2.4 GHz	5 GHz	2.4 GHz	2.4/5 GHz	5 GHz	2.4/5 GHz
Channel BW	20 MHz	20 MHz	20 MHz	20 MHz	20/40 MHz	20/40/80/160 MHz	20/40/80/160 MHz
Peak PHY Rate	2 Mbps	11 Mbps	54 Mbps	54 Mbps	600 Mbps	6.8 Gbps	10 Gbps
Link Spectral Efficiency	0.1 bps/Hz	0.55 bps/Hz	2.7 bps/Hz	2.7 bps/Hz	15 bps/Hz	42.5 bps/Hz	62.5 bps/Hz
Max # SU Streams	1	1	1	1	4	8	8
Max # MU Streams	NA	NA	NA	NA	NA	4 (DL only)	8 (UL & DL)
Modulation	DSSS, FHSS	DSSS, CCK	OFDM	OFDM	OFDM	OFDM	OFDM, OFDMA
Max Constellation / Code Rate	DQPSK	CCK	64-QAM, 3/4	64-QAM, 3/4	64-QAM, 5/6	256-QAM, 5/6	1024-QAM, 5/6
Max # OFDM tones	NA	NA	64	64	128	512	2048
Subcarrier Spacing	NA	NA	312.5 kHz	312.5 kHz	312.5 kHz	312.5 kHz	78.125 kHz

Signal strength, RSSI a CCQ

- **RSSI** - Received Signal Strength Indicator - it is an estimated measure of power level that an RF client device is receiving from an access point or router [dBm]
- **Tx/Rx Rate** - transmission and reception modulation, theoretical max bandwidth [Mbps]



- **Tx/Rx Signal Strength** - The values displayed in the picture are Rx values only. This is the situation when you are connecting to non ROS system [dBm]
- **Tx/Rx CCQ** - Client Connection Quality - is a value in percent that shows how effective the bandwidth is used regarding the theoretically maximum available bandwidth [%]

WifilnfoView - Full Details Mode

SSID	MAC Address	PHY Type	RSSI	Signal Quality	Average Sign...	Frequency	Channel
KROS-wifi	70-E4-22-C5-24-02	802.11g/n	-61	90	87.4	2,462	11
KTK_0	E8-65-D4-CA-F2-51	802.11g/n	-76	57	58.1	2,417	2
linksys	00-8D-40-8D-FB-FF	802.11b	-43	100	98.5	2,437	6
Mikrotik-101	00-0C-42-44-6F-8E	802.11g	-39	100	96.8	2,447	8

- Client's side – **WifilnfoView** app

Channel condition	RSSI range (dBm)
Excellent	≥ -60
Good	-61 to -75
Fair	-76 to -80
Bad	-81 to -89
Very bad	≤ -90

Wireless Tables

WiFi Interfaces W60G Station Nstreme Dual Access List Registration Connect List Se

Reset

Radio Name	MAC Address	Interface	Uptime	AP	W...	Last Activit...	Tx/
wlan1	D0:37:45:E4:CE:59	wlan1	00:38:37	no	no	0.300	-45

AP Client <D0:37:45:E4:CE:59>

General 802.1x Signal Nstreme NV2 Statistics

Last Activity: 0.300 s

Tx/Rx Signal Strength: -45 dBm

Tx/Rx Signal Strength Ch0: -45 dBm

Tx/Rx Signal Strength Ch1:

Tx/Rx Signal Strength Ch2:

Tx/Rx Signal Strength Ch3:

Signal To Noise: 58 dB

Tx/Rx CCQ: 90 %

P Throughput: 30502 kbps

Signal Strengths

Rate	Strength	Last Measured
1Mbps	-45	00:00:00.39
5.5Mbps	-45	00:03:44.33
24Mbps	-44	00:00:50.32
6Mbps	-42	00:00:00.30
9Mbps	-42	00:06:16.24
18Mbps	-42	00:13:30.26
12Mbps	-41	00:23:32.28
36Mbps	-41	00:18:35.84
48Mbps	-41	00:03:20.33

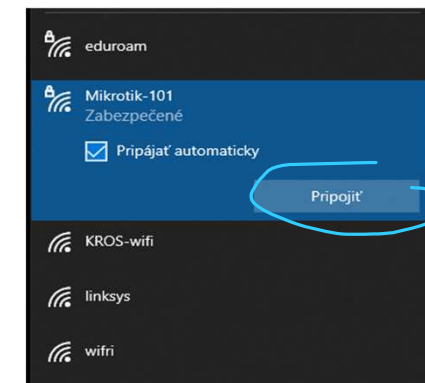
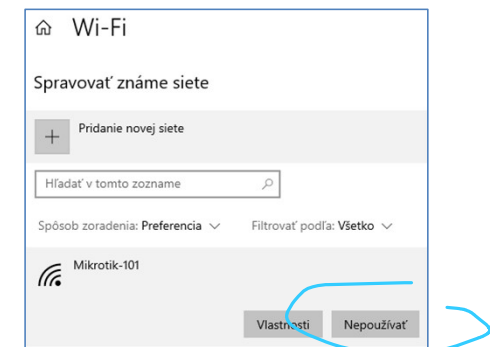
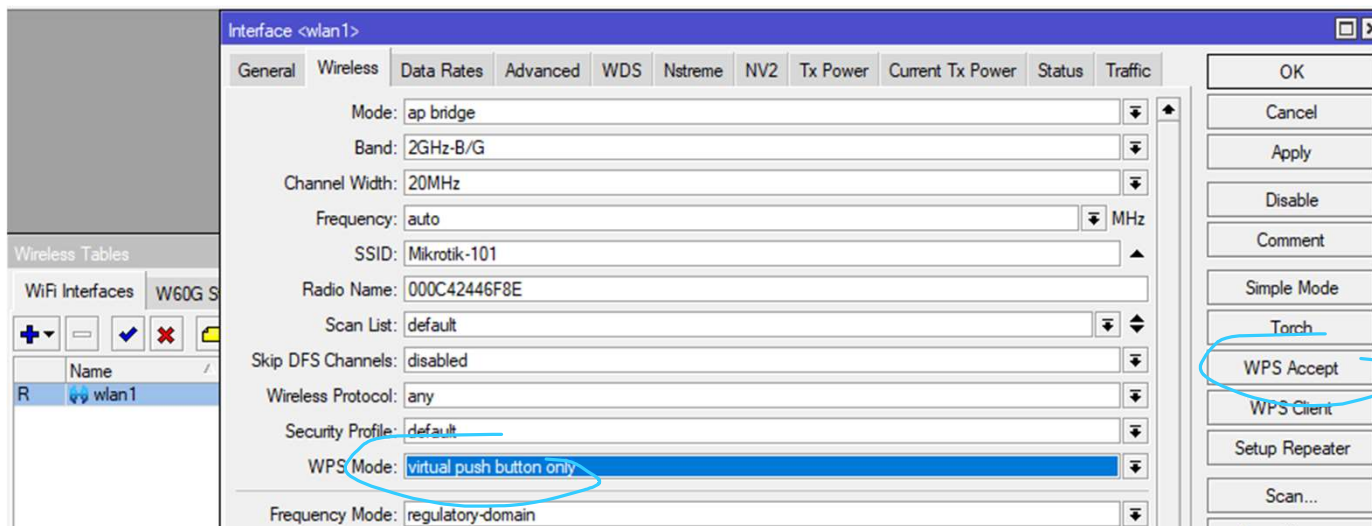
Buttons: OK, Remove, Reset, Copy to Access List, Copy to Connect List, Ping, MAC Ping, Telnet, MAC Telnet, Torch

Wireless: Úloha

1. Zmeniť regulatory-domain na krajinu SK a následne mimo EU (US). Zistiť Tx max vyžarovaný výkon pre jednotlivé krajiny
1. Nastaviť regulatory-domain=SK; zmeniť zisk antény z 2dBi na 20 dBi a zistiť, ako zmena ovplyvní:
 - a) Kvalitu Rx signálu na strane AP a PC klienta (WifilInfoView app)
 - b) Ako ovplyvní CCQ / Signal Quality na strane AP a klienta
 - c) Ako a či nastala zmena MCS / rýchlosti
 - d) Zaznamenať do PPT situáciu pred a po zmene

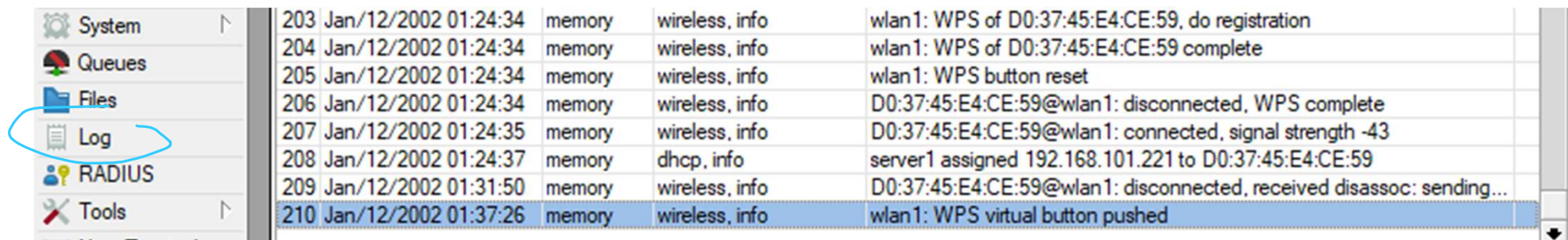
Wi-Fi Protected Setup (WPS)

- Štandard zabezpečenia bezdrôtovej siete, ktorý sa snaží rýchlejšie a ľahšie vytvoriť spojenie medzi smerovačom a AP
- V súčasnosti, z dôvodu bezpečnosti, WPS funguje iba pre bezdrôtové siete, ktoré používajú heslo šifrované pomocou protokolov WPA a WPA2 Personal
- Možnosti pripojenia WPS
 - Prostredníctvom HW alebo SW tlačidla na AP (Mikrotik default WPS timeout 120 sec.)
 - PIN kód generovaný AP



WPS: Úloha

- Zabudnúť WiFi sieť SSID Mikrotik-1[nn]
- Pripojiť sa prostredníctvom WPS SW tlačidla
- Zdokumentovať pripojenie klientského zariadenia z logov Mikrotik AP zariadenia
- Zdokumentovať timeout z logov
- Je potrebné stlačiť “WPS Accept” vopred pred pripojením PC na WiFi sieť?



203	Jan/12/2002 01:24:34	memory	wireless, info	wlan1: WPS of D0:37:45:E4:CE:59, do registration
204	Jan/12/2002 01:24:34	memory	wireless, info	wlan1: WPS of D0:37:45:E4:CE:59 complete
205	Jan/12/2002 01:24:34	memory	wireless, info	wlan1: WPS button reset
206	Jan/12/2002 01:24:34	memory	wireless, info	D0:37:45:E4:CE:59@wlan1: disconnected, WPS complete
207	Jan/12/2002 01:24:35	memory	wireless, info	D0:37:45:E4:CE:59@wlan1: connected, signal strength -43
208	Jan/12/2002 01:24:37	memory	dhcp, info	server1 assigned 192.168.101.221 to D0:37:45:E4:CE:59
209	Jan/12/2002 01:31:50	memory	wireless, info	D0:37:45:E4:CE:59@wlan1: disconnected, received disassoc: sending...
210	Jan/12/2002 01:37:26	memory	wireless, info	wlan1: WPS virtual button pushed

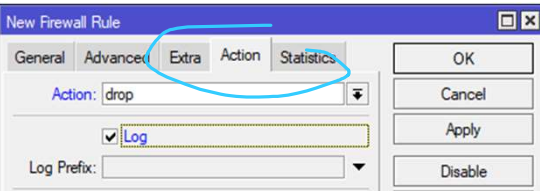
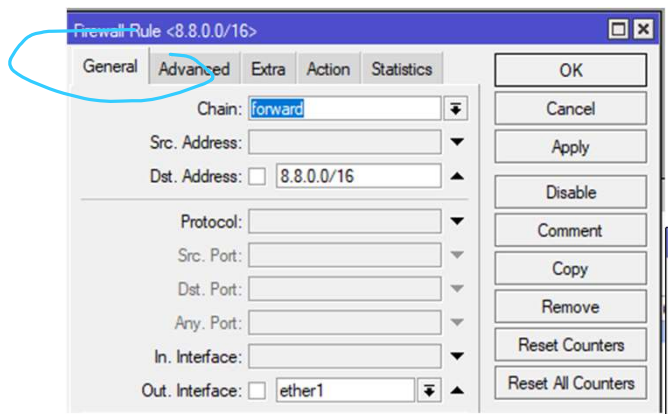
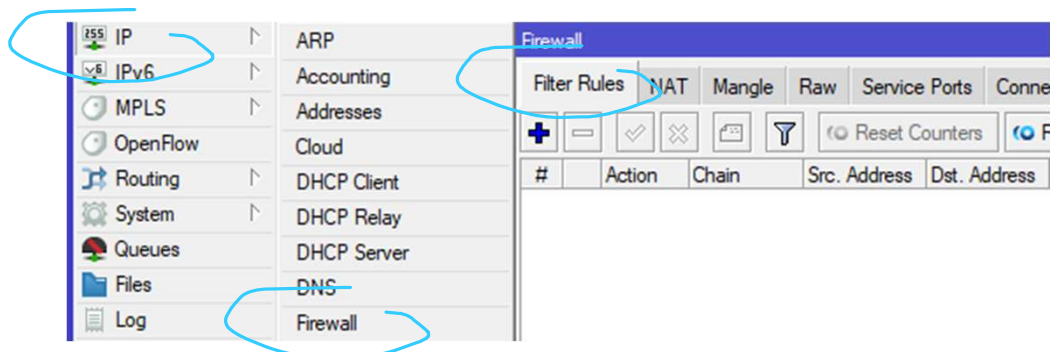
IP FW

- Možnosť nastaviť Firewall pravidlá pre IP prevádzku

```
C:\Users\student>ping 8.8.8.8  
  
Pinging 8.8.8.8 with 32 bytes of data:  
Reply from 8.8.8.8: bytes=32 time=10ms TTL=57  
Reply from 8.8.8.8: bytes=32 time=10ms TTL=57
```

```
C:\Users\student>ping 8.8.8.8  
  
Pinging 8.8.8.8 with 32 bytes of data:  
Request timed out.  
Request timed out.
```

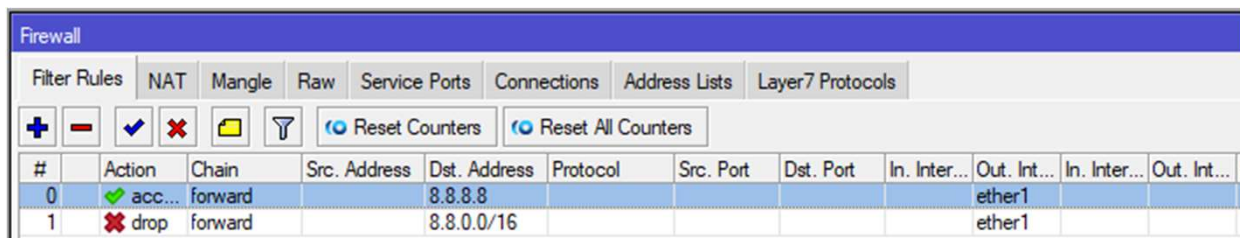
```
C:\Users\student>ping 8.8.4.4  
  
Pinging 8.8.4.4 with 32 bytes of data:  
Request timed out.  
Request timed out.
```



299	Jan/12/2002 01:59:31	memory	firewall, info	forward: in:wlan1 out:ether1, src-mac d0:37:45:e4:ce:59, proto ICMP (type 8, code 0), 192.168.101.221->8.8.8.8, len 60
300	Jan/12/2002 01:59:36	memory	firewall, info	forward: in:wlan1 out:ether1, src-mac d0:37:45:e4:ce:59, proto ICMP (type 8, code 0), 192.168.101.221->8.8.8.8, len 60

IP FW: Úloha

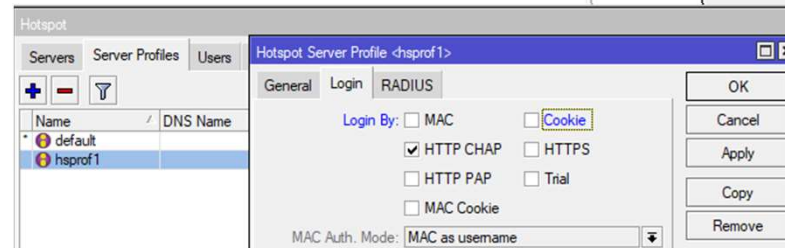
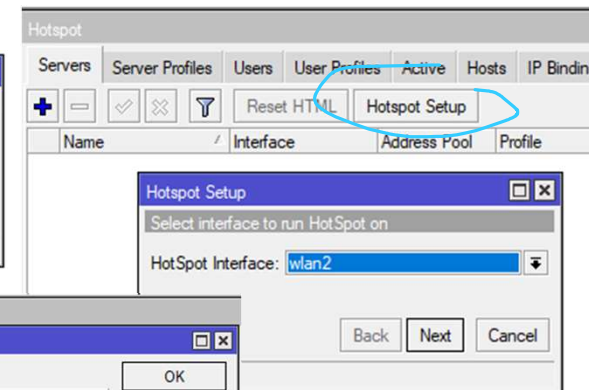
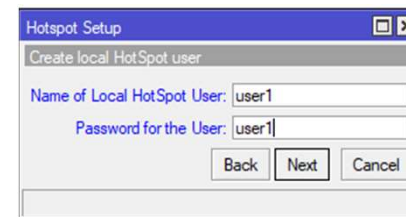
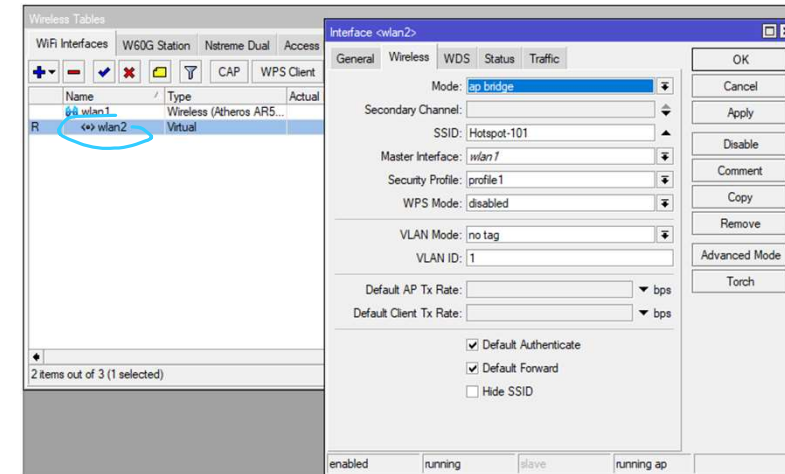
- Pridať FW pravidlo, tak, aby ping na verejný DNS server 8.8.8.8 bol povolený, avšak sieť 8.8.0.0/16 bola zakázaná
- Zdokumentovať, screenshot pravidla a ping, log záznam pre povolenú IP adresu, spolu s NAT informáciou povoleného ping paketu z PC



#	Action	Chain	Src. Address	Dst. Address	Protocol	Src. Port	Dst. Port	In. Inter...	Out. Int...	In. Inter...	Out. Int...
0	allow	forward		8.8.8.8					ether1		
1	drop	forward		8.8.0.0/16					ether1		

Hotspot

- WiFi Hotspot umožňuje zdieľať WiFi pripojenie k internetu pre hostí, ktorým nechceme poskytnúť náš WPA kľúč
- Postup:
 - Vytvoriť nový wireless iface s SSID Hotspot-1[nn]
 - Nový "Security Profile s Auth módom NONE"
 - IP -> Hotspot -> Servers -> Hotspot Setup
 - Local address 192.168.2[nn].1/24
 - Masquerade Net – YES
 - Address pool 192.168.2[nn].201-192.168.2[nn].221
 - Select certificate NONE
 - No SMTP
 - DNS 8.8.8.8, no name
 - Local Hotspot user: user1/user1
 - Hotspot Server Profile Login options:
 - HTTP CHAP only



Hotspot: Úloha

- Pripojiť sa na SSID Hotspot-1[nn] sieť, skontrolovať a zdokumentovať routovaciu tabuľku a default route na PC (NetRouterView), mal by byť preferovaný cez Wifi sieť
- Automaticky otvorený Web browser na IP adresu <http://192.168.201.1/login> -> NEPRIHLASOVAŤ
- Zdokumentovať príkaz tracer 8.8.8.8
- Web PRIHLÁSENIE (user1/user1) - automaticky otvorený Web browser na IP adresu <http://192.168.201.1/login>
- Zdokumentovať príkaz tracer 8.8.8.8
- <http://192.168.201.1/status>



Ďakujem za pozornosť.

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- Vytvorené v rámci projektu KEGA 026TUKE-4/2021