

# OTIMIZAÇÃO DE SISTEMAS WIRELESS

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**CENTRAL DE TELEVENDAS**

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# Agenda

- **Discussão sobre os padrões Wi-Fi**
- **Mikrotik Wireless Tools**
- **Throughput real do padrão Wi-Fi**
- **Redes PTP e PTMP**
- **Nstreme x CSMA/CA**
- **Nstreme2**

# Wi-Fi 802.11 a,b,g,n

**Padrões desenvolvidos para redes  
locais - LAN**

**802.11a : 54Mbps – 5 GHz**

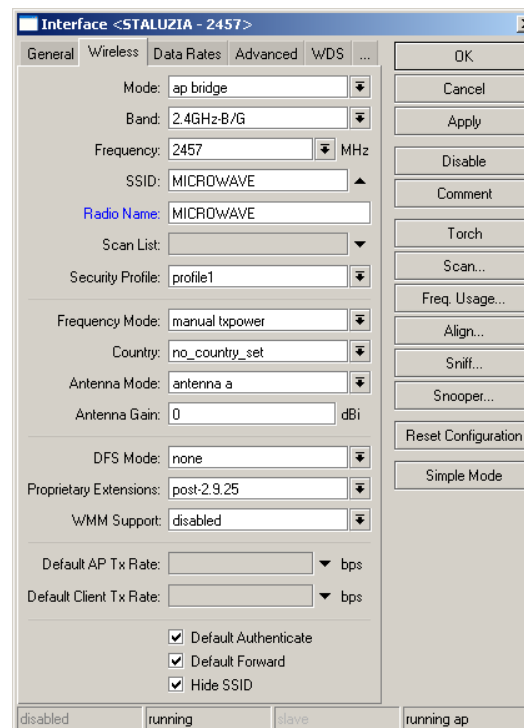
**802.11b : 11Mbps – 2.4 GHz**

**802.11g : 54Mbps – 2.4 GHz**

**802.11n : 300Mbps – 2.4 GHz (*draft*)**

# Wi-Fi 802.11 a,b,g,n

Ativando uma interface wireless no Mikrotik RouterOS.



# Wi-Fi 802.11 a,b,g,n

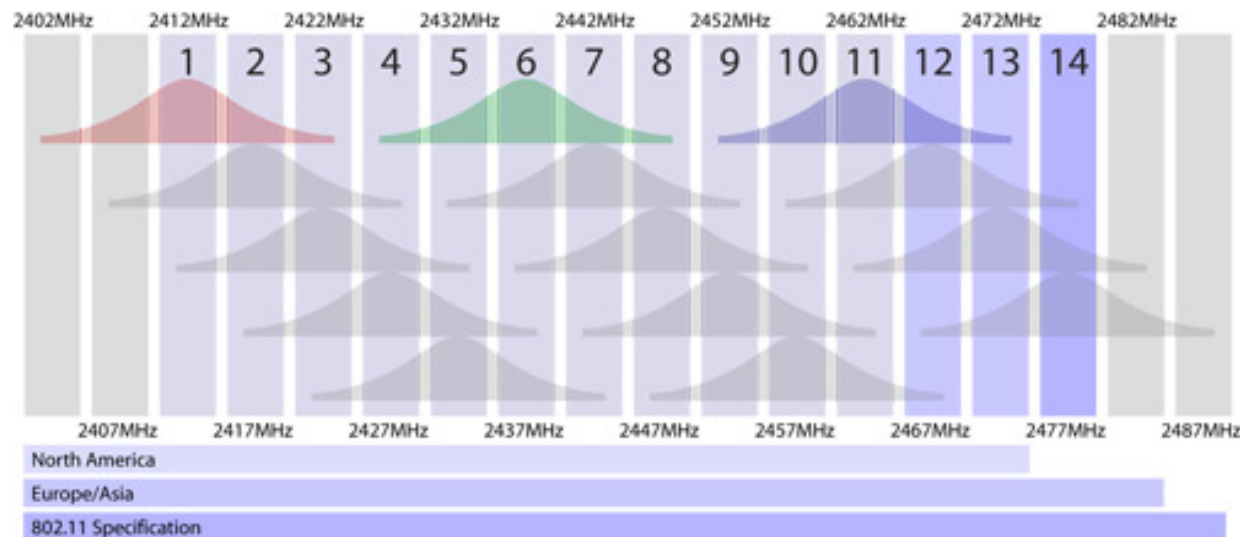
Problemas encontrados nos padrões Wi-Fi:

- Interface aérea desenhada para **redes locais**.
- Transmissão **half-duplex**
- Mobilidade restrita – sistemas nômades
- Banda ISM – Freqüências não licenciadas

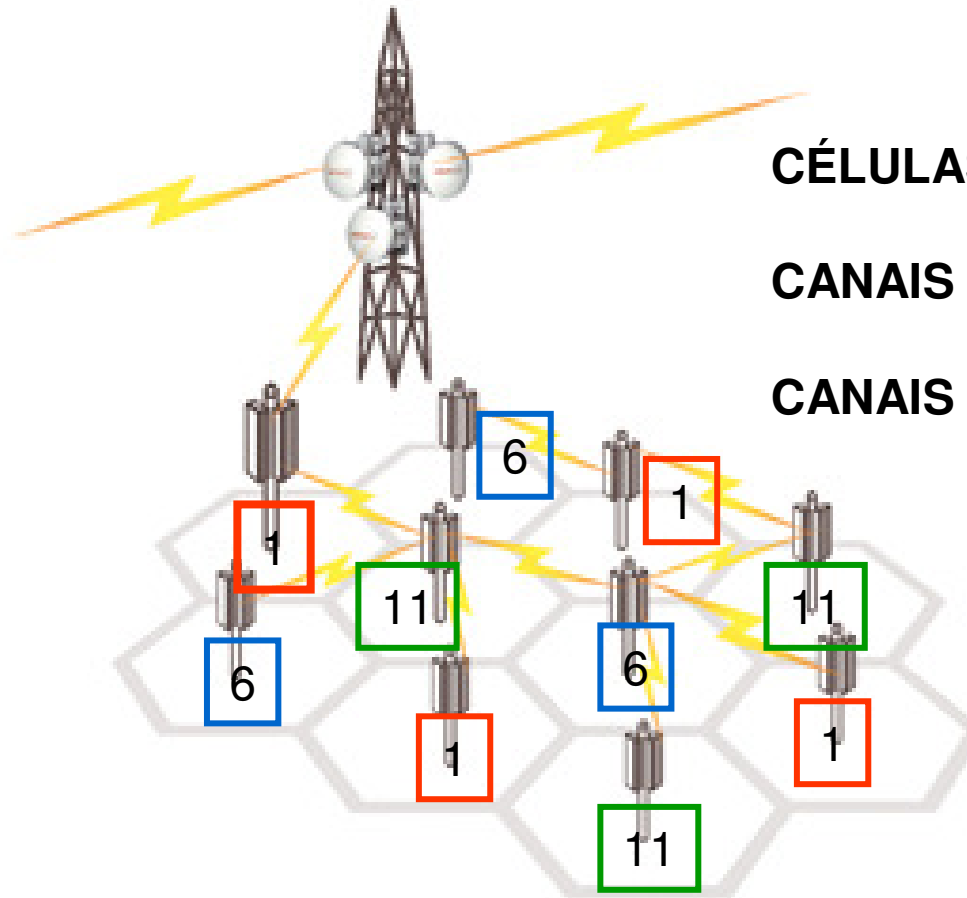
# Sobreposição de canais

Padrão Wi-Fi mais utilizado entre provedores WISP no Brasil é o 802.11b,g.

Canais não sobrepostos : 03



# Técnica de Reuso de Frequências





**CÉLULAS = 10**

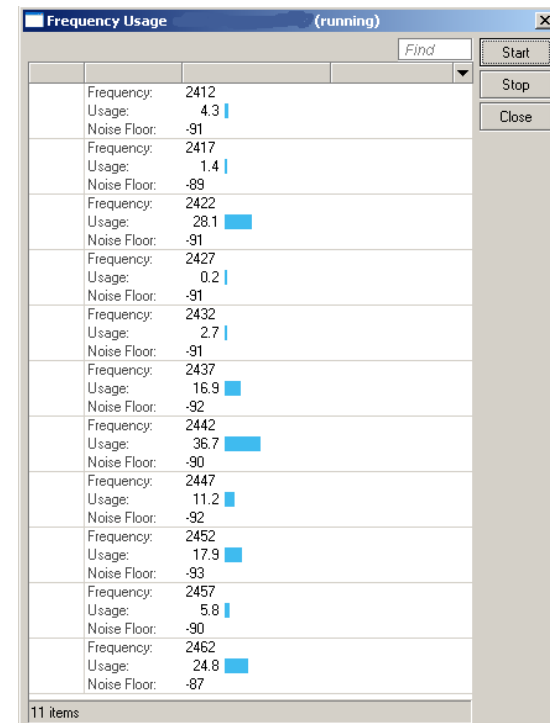
**CANAIS DISPONÍVEIS = 11**

**CANAIS UTILIZADOS = 3**

# Mikrotik Frequency Usage

- Carga de tráfego por canais

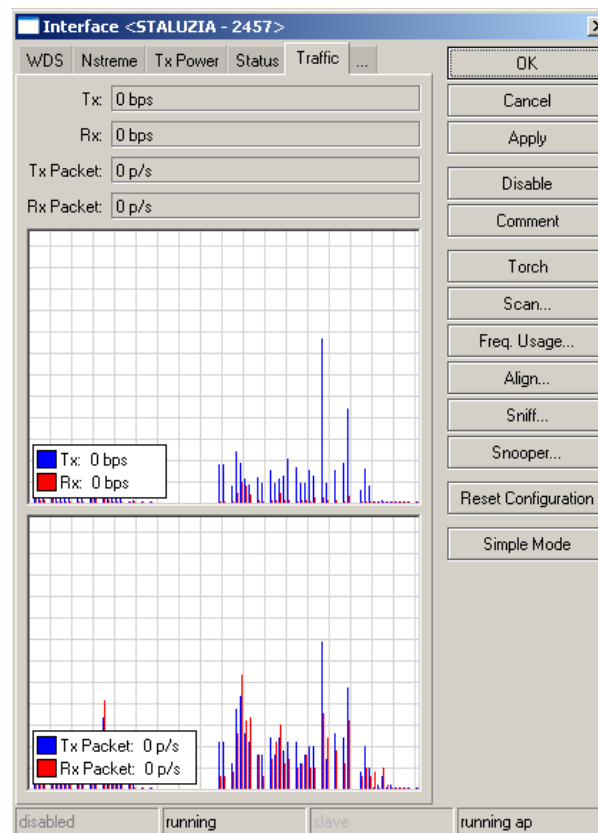
Frequency:	2437
Usage:	16.9 
Noise Floor:	-92
<hr/>	
Frequency:	2442
Usage:	36.7 
Noise Floor:	-90





# Tráfego

Tráfego em tempo real da interface wireless



# Qualidade do Sinal

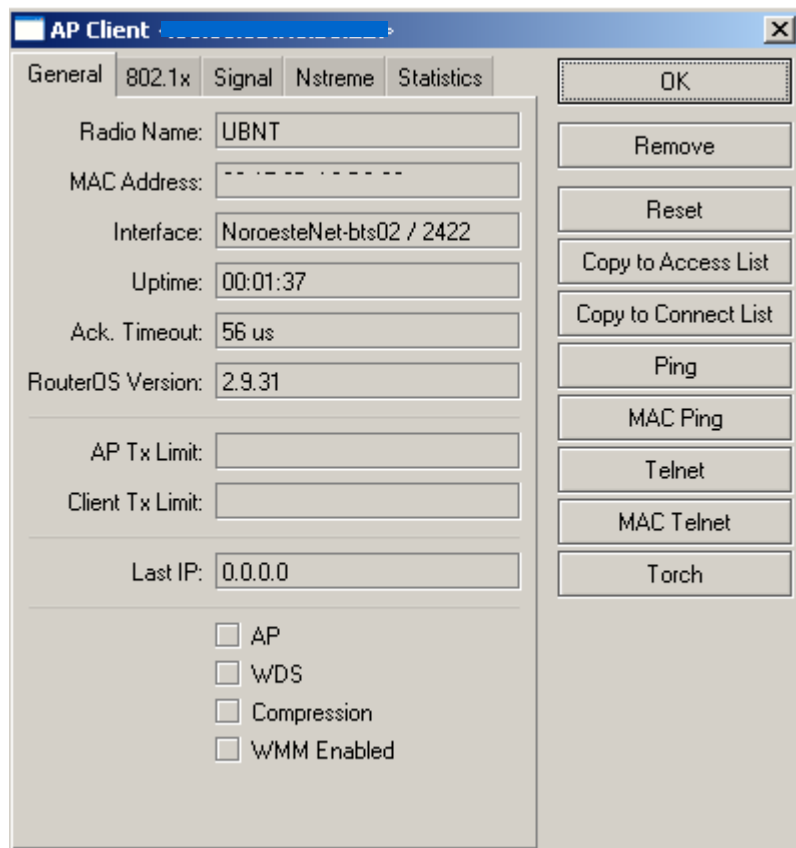
A qualidade de um sinal é determinada por:

- Relação sinal ruído
- Tecnologia de modulação
- Análise de interferências de canal adjacente
- Análise de interferências de fontes diversas

# Qualidade do Sinal

Wireless Tables										
Interfaces Nstreame Dual Access List Registration Connect List Security Profiles										
[-] [Filter] [Reset]										
Radio Name	MAC Address	Interface	Uptime	AP	W...	Last Activity (s)	Signal Strength (dBm)	Signal To Noise (d...	Tx/Rx CCQ (%)	
<b>--- DIFUSA01 ---</b>										
	00:0A:52:7A:1D:0B	DIFUSA01	1d 02:43:45	no	no	13.710	-61	33	99/0	
	00:05:9E:89:C8:ED	DIFUSA01	03:05:33	no	no	1.070	-53	41	92/0	
<b>--- DIFUSA02 ---</b>										
	00:05:63	DIFUSA02	3d 10:05:41	no	no	1.100	-49	43	100/0	
	00:05:1B	DIFUSA02	3d 10:05:41	no	no	1.740	-59	33	99/0	
	00:05:16	DIFUSA02	3d 10:05:41	no	no	13.190	-61	31	100/0	
	00:05:8C	DIFUSA02	3d 10:05:41	no	no	13.210	-76	16	95/0	
	00:12:45	DIFUSA02	3d 10:05:41	no	no	13.190	-59	33	95/0	
	00:05:65	DIFUSA02	1d 22:03:55	no	no	1.260	-44	48	94/0	
	00:05:9D	DIFUSA02	1d 22:03:53	no	no	13.210	-53	39	97/0	
	00:12:E1	DIFUSA02	1d 03:40:47	no	no	13.180	-72	20	100/0	
	00:04:0F	DIFUSA02	12:23:30	no	no	13.210	-65	27	100/0	
	00:05:D1	DIFUSA02	10:48:32	no	no	0.470	-47	45	100/0	
	00:05:71	DIFUSA02	06:15:58	no	no	0.040	-52	40	87/0	
	00:05:D9	DIFUSA02	04:00:41	no	no	0.780	-71	21	99/0	
	00:12:80	DIFUSA02	03:51:04	no	no	0.720	-46	46	98/0	
	00:12:BB	DIFUSA02	03:36:20	no	no	0.110	-55	37	100/0	
	00:04:F5	DIFUSA02	01:31:41	no	no	2.340	-53	39	93/0	
	00:05:25	DIFUSA02	00:21:25	no	no	1.260	-60	32	99/0	
	00:05:66	DIFUSA02	00:03:31	no	no	12.220	-52	40	79/0	
	00:12:63	DIFUSA02	00:03:30	no	no	13.190	-60	32	77/0	
	00:05:17	DIFUSA02	00:03:30	no	no	1.510	-64	28	83/0	
	00:05:DA	DIFUSA02	00:03:30	no	no	12.220	-70	22	84/0	
	00:04:C2	DIFUSA02	00:00:48	no	no	1.910	-56	36	95/0	
	00:02:D6	DIFUSA02	00:00:48	no	no	1.530	-63	29	48/0	
	00:04:F0	DIFUSA02	00:00:47	no	no	0.050	-75	17	98/0	

# Qualidade do Sinal



AP Client [802.1x] OK

General | 802.1x | Signal | Nstreme | Statistics

Radio Name: UBNT

MAC Address: - - - - -

Interface: NoroesteNet-bts02 / 2422

Uptime: 00:01:37

Ack. Timeout: 56 us

RouterOS Version: 2.9.31

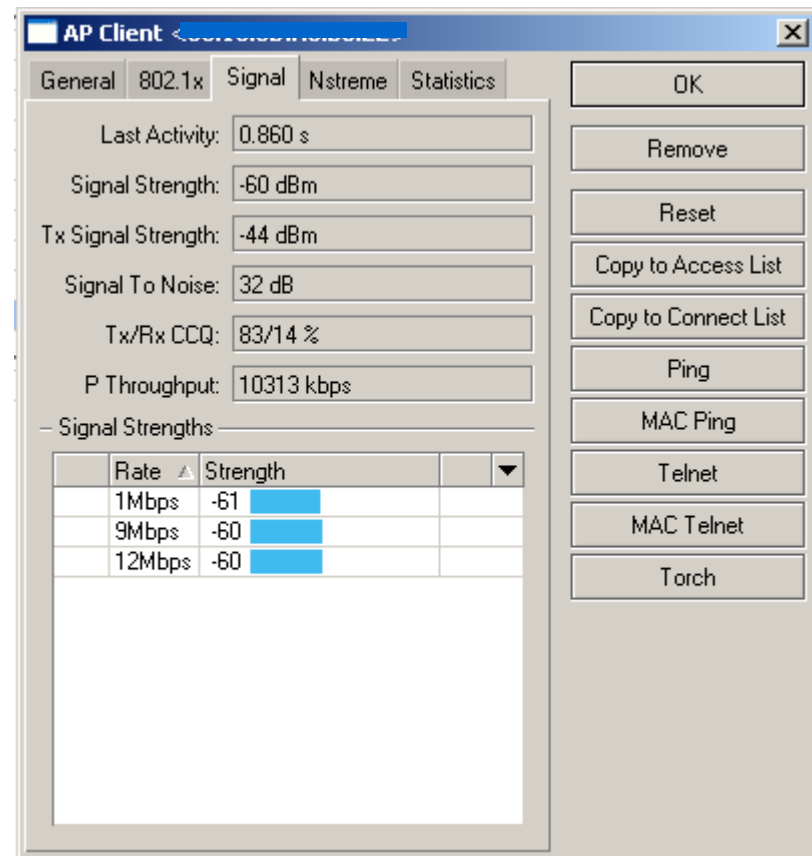
AP Tx Limit:

Client Tx Limit:

Last IP: 0.0.0.0

AP  
 WDS  
 Compression  
 WMM Enabled

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



AP Client [802.1x] OK

General | 802.1x | Signal | Nstreme | Statistics

Last Activity: 0.860 s

Signal Strength: -60 dBm

Tx Signal Strength: -44 dBm

Signal To Noise: 32 dB

Tx/Rx CCQ: 83/14 %

P Throughput: 10313 kbps

- Signal Strengths:

Rate	Strength
1Mbps	-61
9Mbps	-60
12Mbps	-60

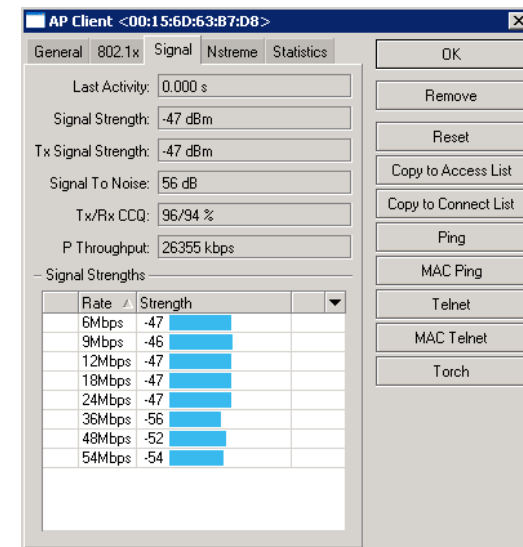
Buttons: OK, Remove, Reset, Copy to Access List, Copy to Connect List, Ping, MAC Ping, Telnet, MAC Telnet, Torch

# Qualidade do Sinal

Relação Sinal Ruído – SNR: **56 dB**

Tx/Rx CCQ: **96/94%**

P Throughput: **26355 kbps**



Tx/Rx CCQ: Eficiência da banda. Quanto menor, maiores serão as retransmissões.

# Banda Disponível

AP Client

General 802.1x Signal Nstreme Statistics

Last Activity: 0.040 s

Signal Strength: -63 dBm

Tx Signal Strength: -60 dBm

Signal To Noise: 27 dB

Tx/Rx CCQ: 30/51 %

P Throughput: 4911 kbps

Signal Strengths

Rate	Strength
1Mbps	-63
9Mbps	-63
12Mbps	-62
18Mbps	-63
24Mbps	-64
36Mbps	-64

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

AP Client

General 802.1x Signal Nstreme Statistics

Last Activity: 0.000 s

Signal Strength: -48 dBm

Tx Signal Strength: -46 dBm

Signal To Noise: 55 dB

Tx/Rx CCQ: 97/96 %

P Throughput: 28672 kbps

Signal Strengths

Rate	Strength
6Mbps	-48
9Mbps	-46
12Mbps	-47
18Mbps	-47
24Mbps	-47
36Mbps	-56
48Mbps	-53
54Mbps	-54

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

# Detalhes Técnicos Indispensáveis

- **Aterramento**
- Análise Espectral – Canais Interferêntes
- Polarização de Antenas
- Cabos adequados
- Equipamentos de Qualidade e Procedência

# Performance e Otimização com Protocolos Mikrotik



# NSTREME

- **Protocolo proprietário Mikrotik**
- **Provê melhorias ao throughput**
- **Maior estabilidade em Enlaces PTP e PTMP**
- **Funcional apenas em redes Mikrotik**

# NSTREME

## EXEMPLO:

```
[admin@MikroTik] interface wireless
nstreme> print 0 name="wlan1" enable-
nstreme=no enable-polling=yes framer-
policy=none framer-limit=3200
[admin@MikroTik] interface wireless
nstreme> set wlan1 enable-nstreme=yes \
\... framer-policy=exact-size
```

# NSTREME

Framer-policy

Vejamos algumas políticas de otimização:

**none** – sem combinações de frames

**best-fit** – insere o máximo de pacotes até atingir a capacidade definida pelo **frame-limit**, sem fragmentar o pacote.

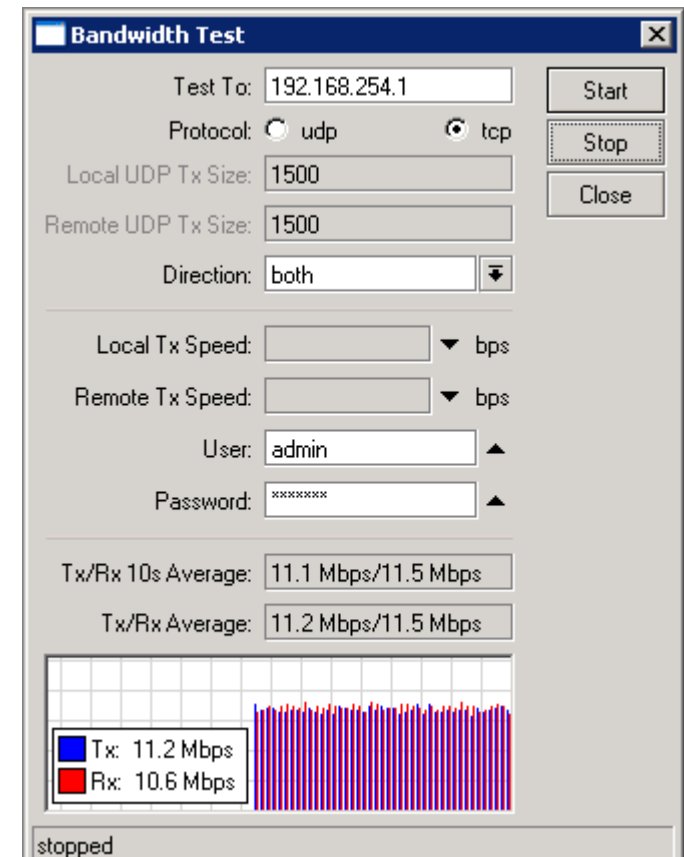
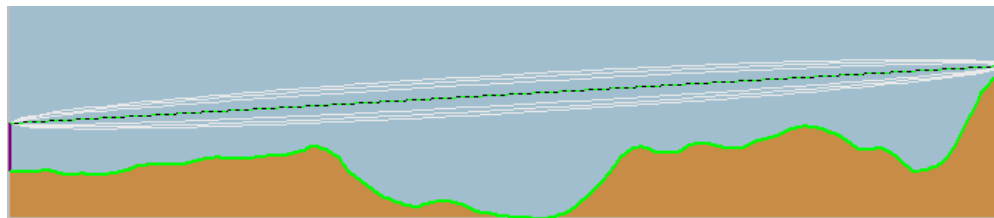
**exact-size** - Insere o máximo de pacotes até atingir a capacidade definida pelo **frame-limit**, podendo fragmentar o pacote. (melhor performance)

**dynamic-size** – Escolhe o melhor tamanho

# CSMA/CA X NSTREME

Testes práticos:

- Enlace de ~**30 km**
- Frequência, **5.8 GHz**



# CSMA/CA X NSTREME

## ENLACES BASEADOS EM CSMA/CA – half duplex

- Throughput médio: **10,3 Mbps**
- Modulação: **OFDM – 802.11a**
- Range: **~30 km**

## ENLACES BASEADOS EM NSTREME – half duplex

- Throughput médio: **28 Mbps**
- Modulação: **OFDM – 802.11a**
- Range: **~30 km**

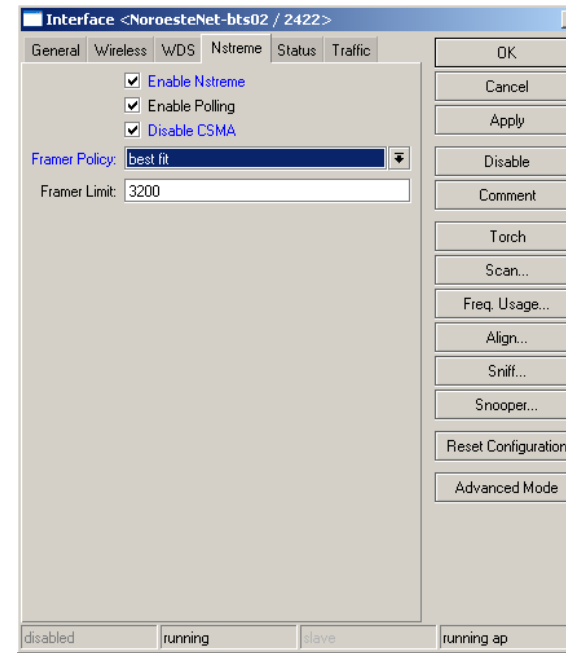
# CSMA/CA X NSTREME

Configuração

Modos de operação:

AP bridge ou WDS

Para clientes WDS a configuração deve permanecer como station-wds.



# NSTREME

Framer-policy

Este método diz respeito ao tipo de combinações de frames.

Podemos otimizar a transmissão combinando uma série de *frames* e um só com maior capacidade de transmissão, reduzindo assim o *overhead* (sobrecarga de bits de sinalização), oferecendo uma melhoria significativa no *throughput* (capacidade de tráfego) da transmissão.

# NSTREME2

Dois rádios na interface nstreme-dual-mode slave podem ser agrupados em uma conexão ponto-a-ponto.

Para utilizar este método o modo de configuração dos rádios deverá permanecer no **nstreme-dual-slave**.



# NSTREME2

Muitos parâmetros das interfaces wireless serão desativados utilizando o nstreme2, exceto:

- frequency-mode
- country
- antenna-gain
- tx-power
- tx-power-mode
- antenna-mode

# NSTREME2

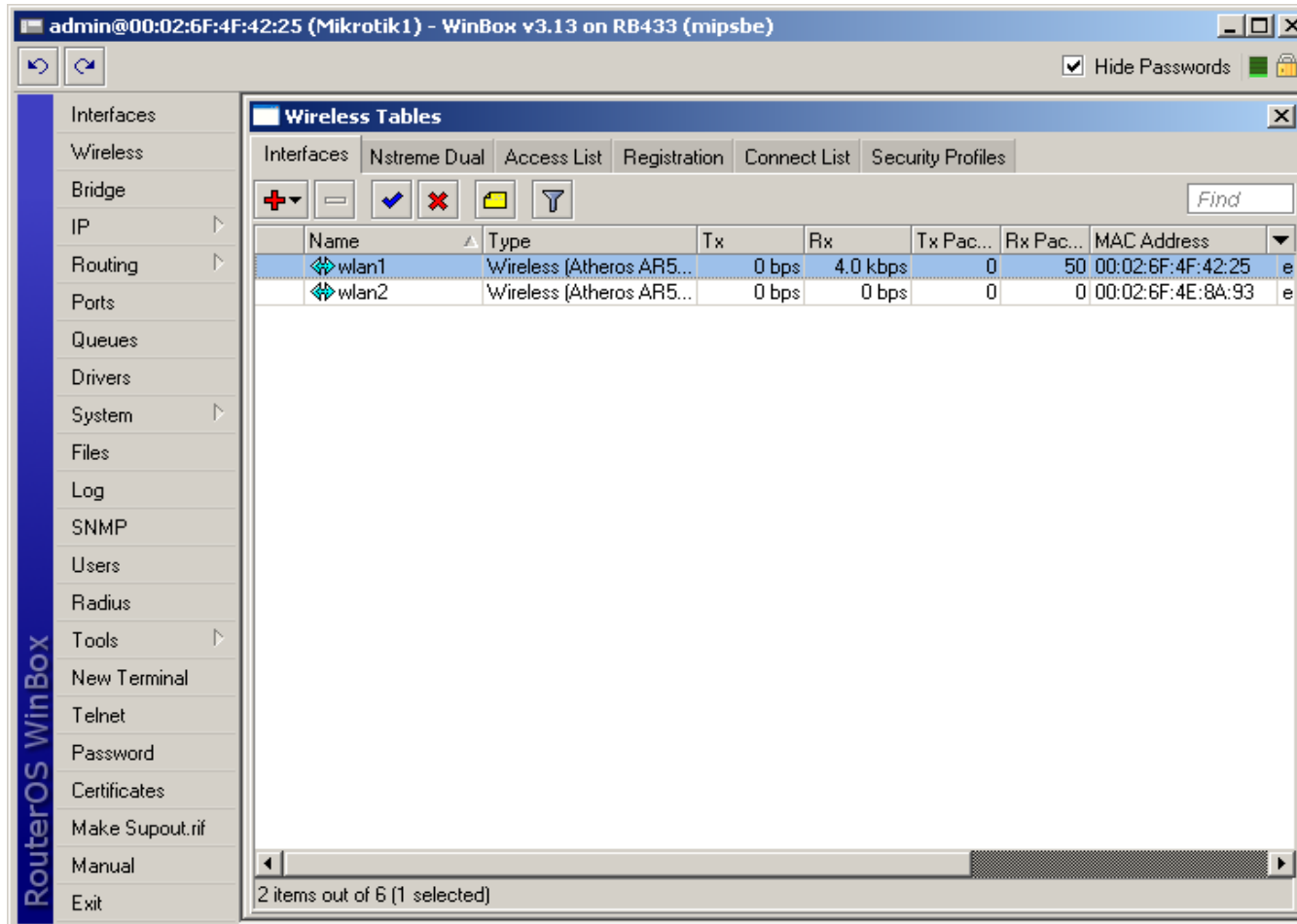
- A diferença entre TX-freq e RX- freq deve ser igual ou superior 200 MHz.
- Podemos utilizar frequências diferentes entre Rx e Tx (2,4GHz e 5.8GHz)

# NSTREME2

- Vamos agora configurar um enlace com NSTREME2, passo a passo.

# NSTREME2

Configurar as interfaces wireless no modo nstreme dual slave

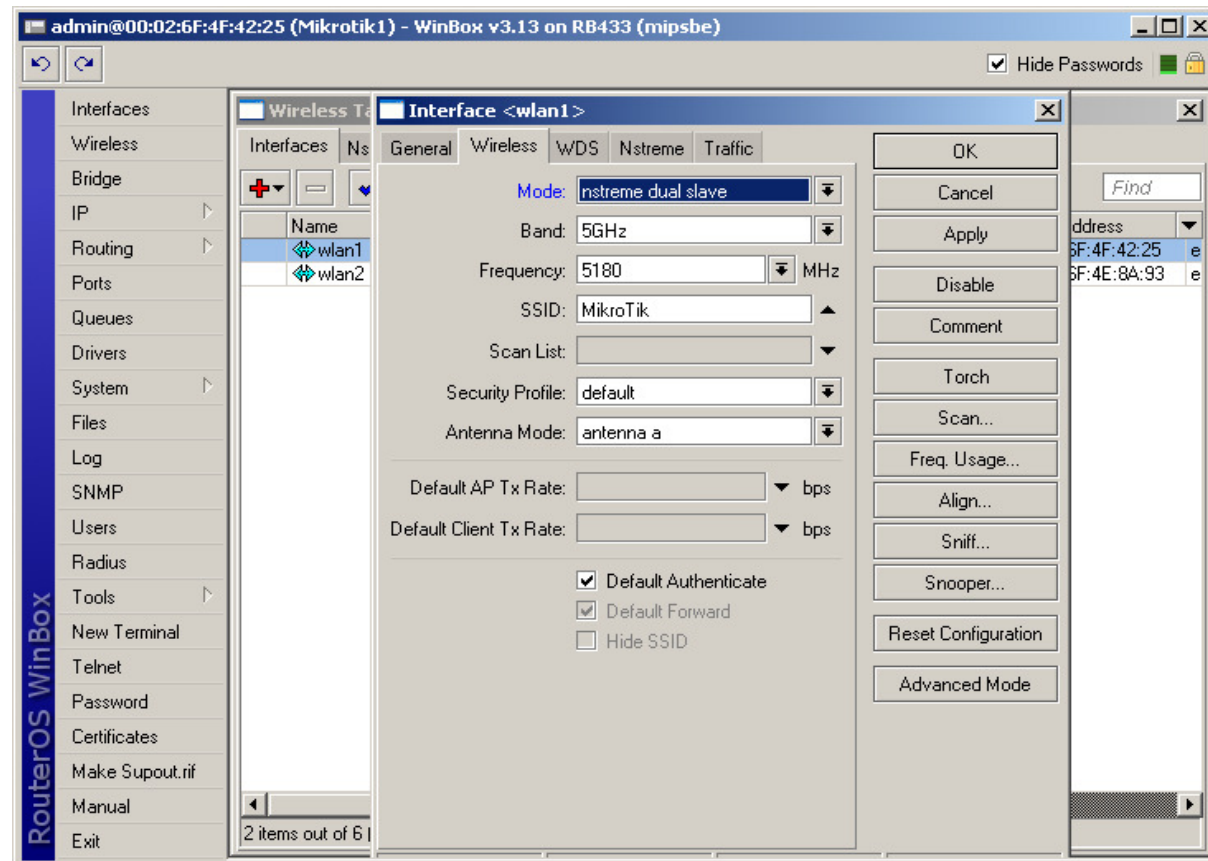


The screenshot shows the WinBox interface for a Mikrotik RB433 router. The main window is titled "Wireless Tables" and displays a table of wireless interfaces. The table has columns for Name, Type, Tx, Rx, Tx Pac..., Rx Pac..., and MAC Address. Two interfaces are listed: wlan1 and wlan2. wlan1 has a Tx rate of 0 bps and a Rx rate of 4.0 kbps, with a MAC address of 00:02:6F:4F:42:25. wlan2 has a Tx rate of 0 bps and a Rx rate of 0 bps, with a MAC address of 00:02:6F:4E:8A:93. The interface is currently in the "Nstreme Dual" tab.

Name	Type	Tx	Rx	Tx Pac...	Rx Pac...	MAC Address
wlan1	Wireless (Atheros AR5...	0 bps	4.0 kbps	0	0	00:02:6F:4F:42:25
wlan2	Wireless (Atheros AR5...	0 bps	0 bps	0	0	00:02:6F:4E:8A:93

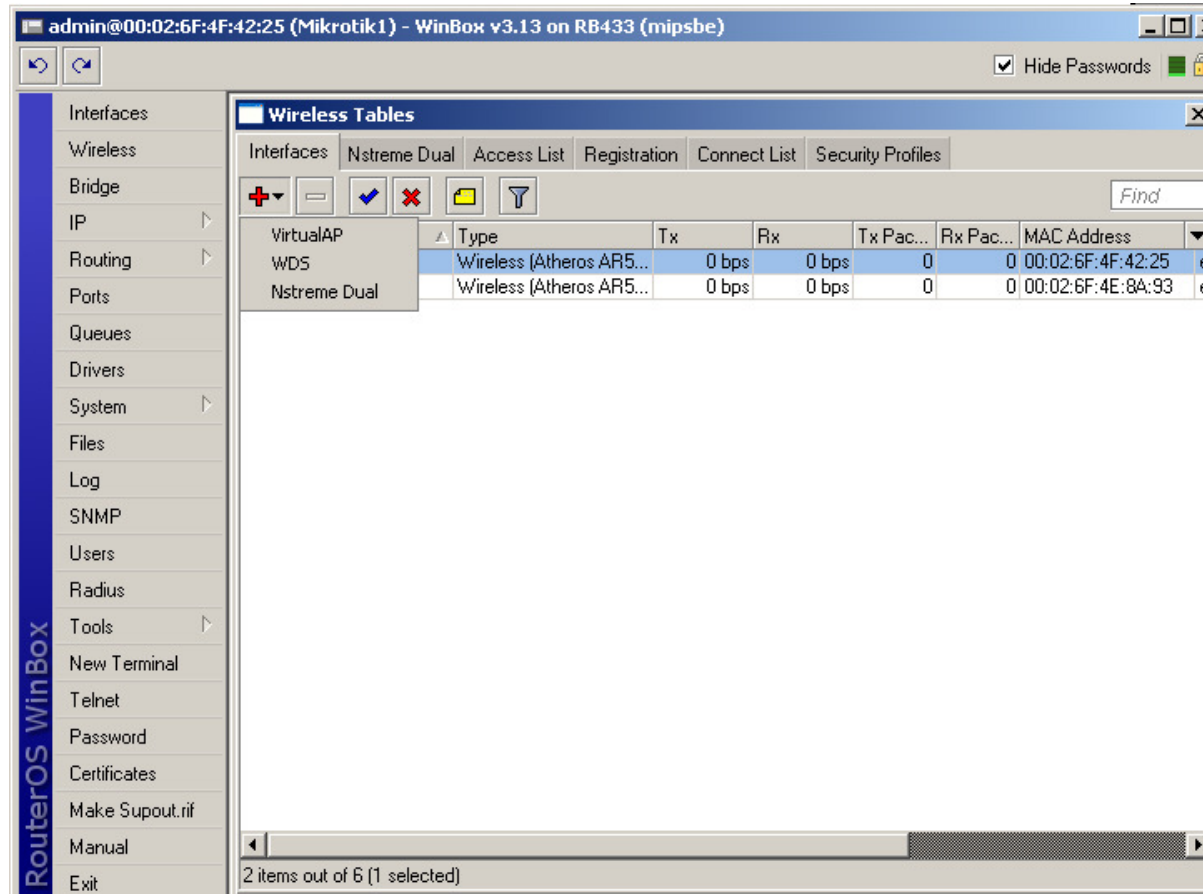
# NSTREME2

Entre na configuração de cada interface e altere o modo de operação para nstreme dual slave. Não é necessário configurar a frequência.



# NSTREME2

Entre em Interfaces, clique em Add (+) e adicione uma interface Nstreme Dual.



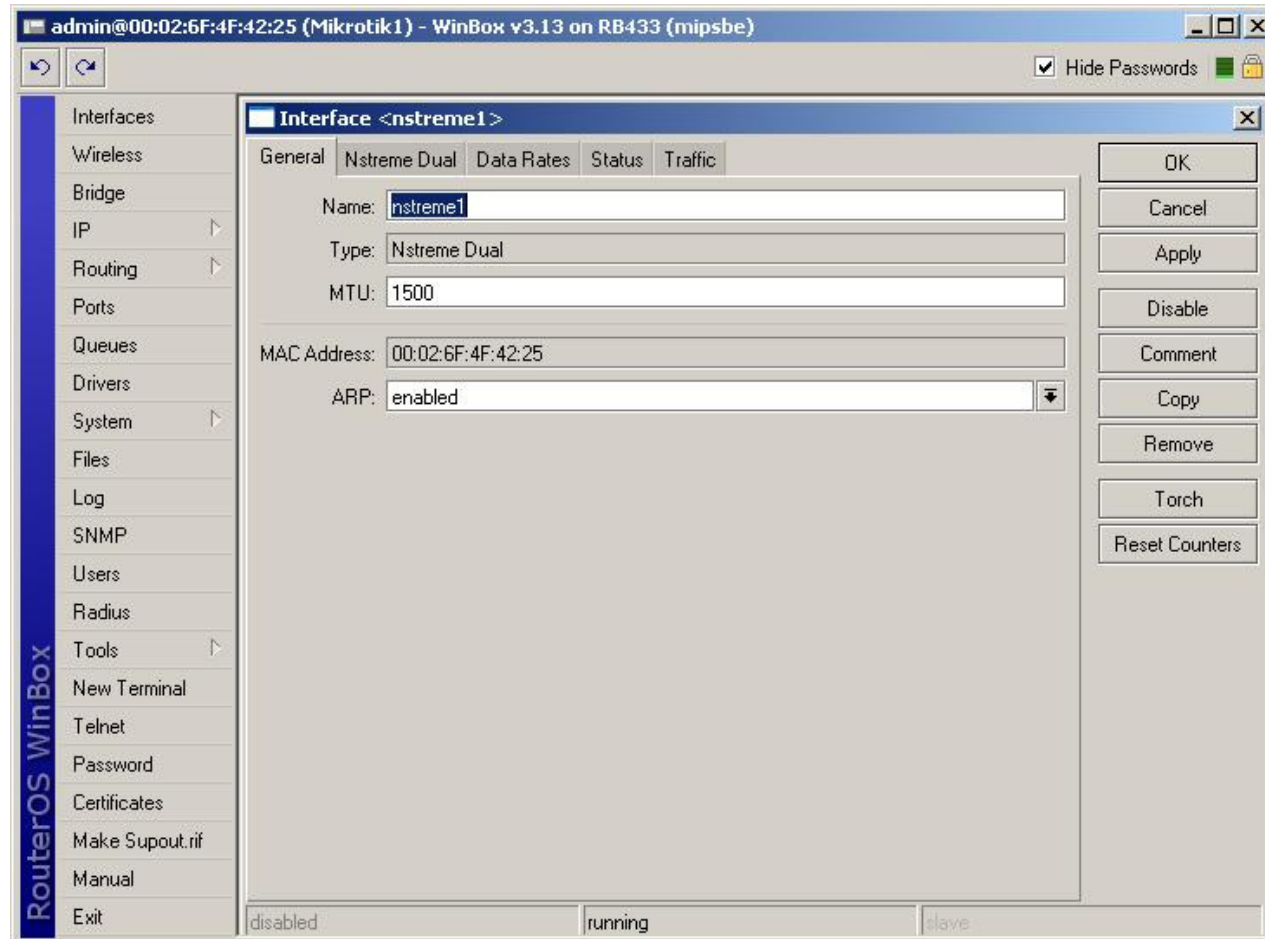
The screenshot shows the WinBox v3.13 interface on a Mikrotik RB433 (mipsbe). The main window is titled "Wireless Tables" and displays a table with the following data:

VirtualAP	Type	Tx	Rx	Tx Pac...	Rx Pac...	MAC Address
WDS	Wireless (Atheros AR5...	0 bps	0 bps	0	0	00:02:6F:4F:42:25 e
Nstreme Dual	Wireless (Atheros AR5...	0 bps	0 bps	0	0	00:02:6F:4E:8A:93 e

The interface also shows a sidebar with various configuration options like Interfaces, Wireless, Bridge, IP, Routing, Ports, Queues, Drivers, System, Files, Log, SNMP, Users, Radius, Tools, New Terminal, Telnet, Password, Certificates, Make Supout.rif, Manual, and Exit. The status bar at the bottom indicates "2 items out of 6 (1 selected)".

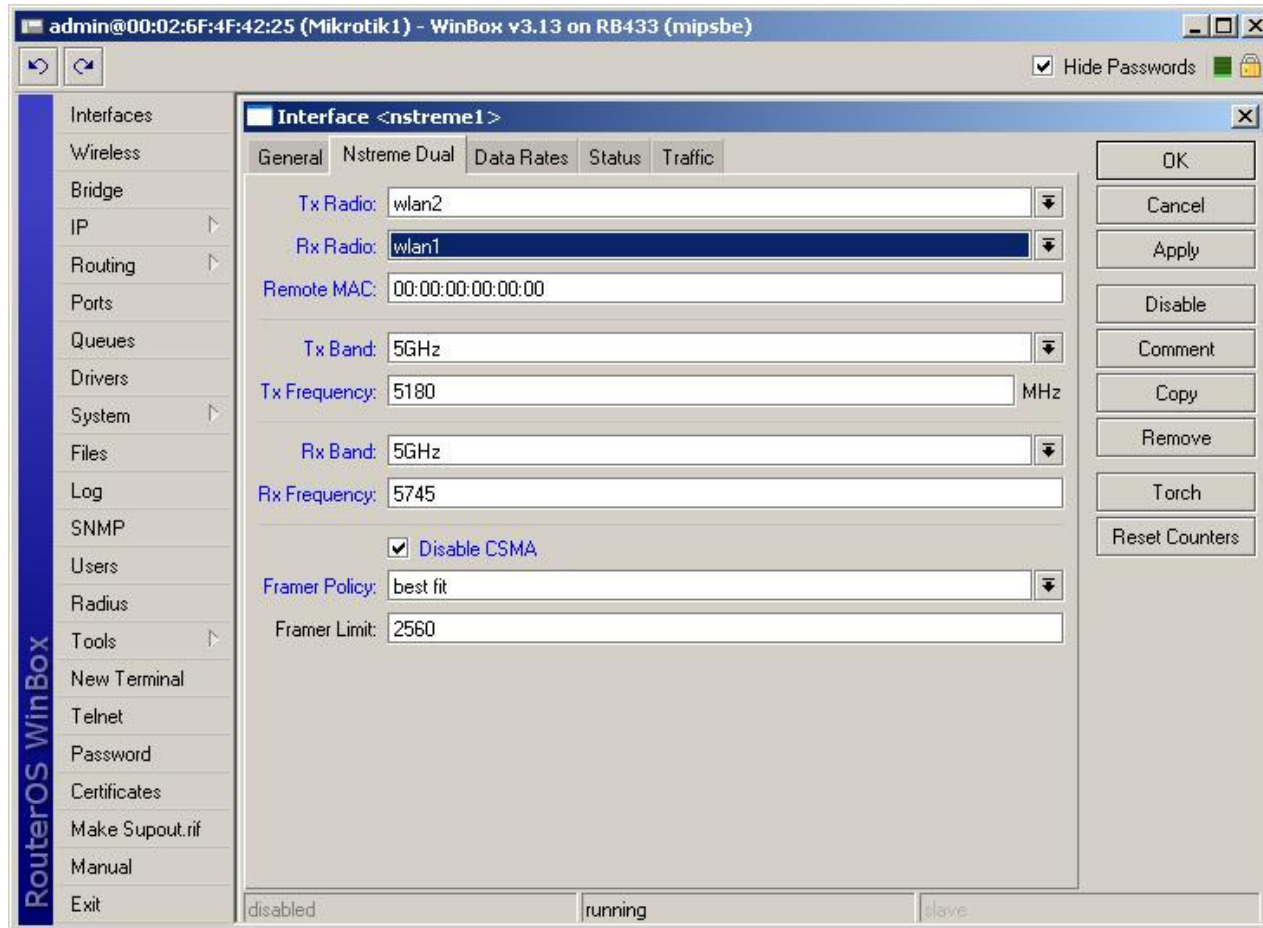
# NSTREME2

## Mikrotik1



# NSTREME2

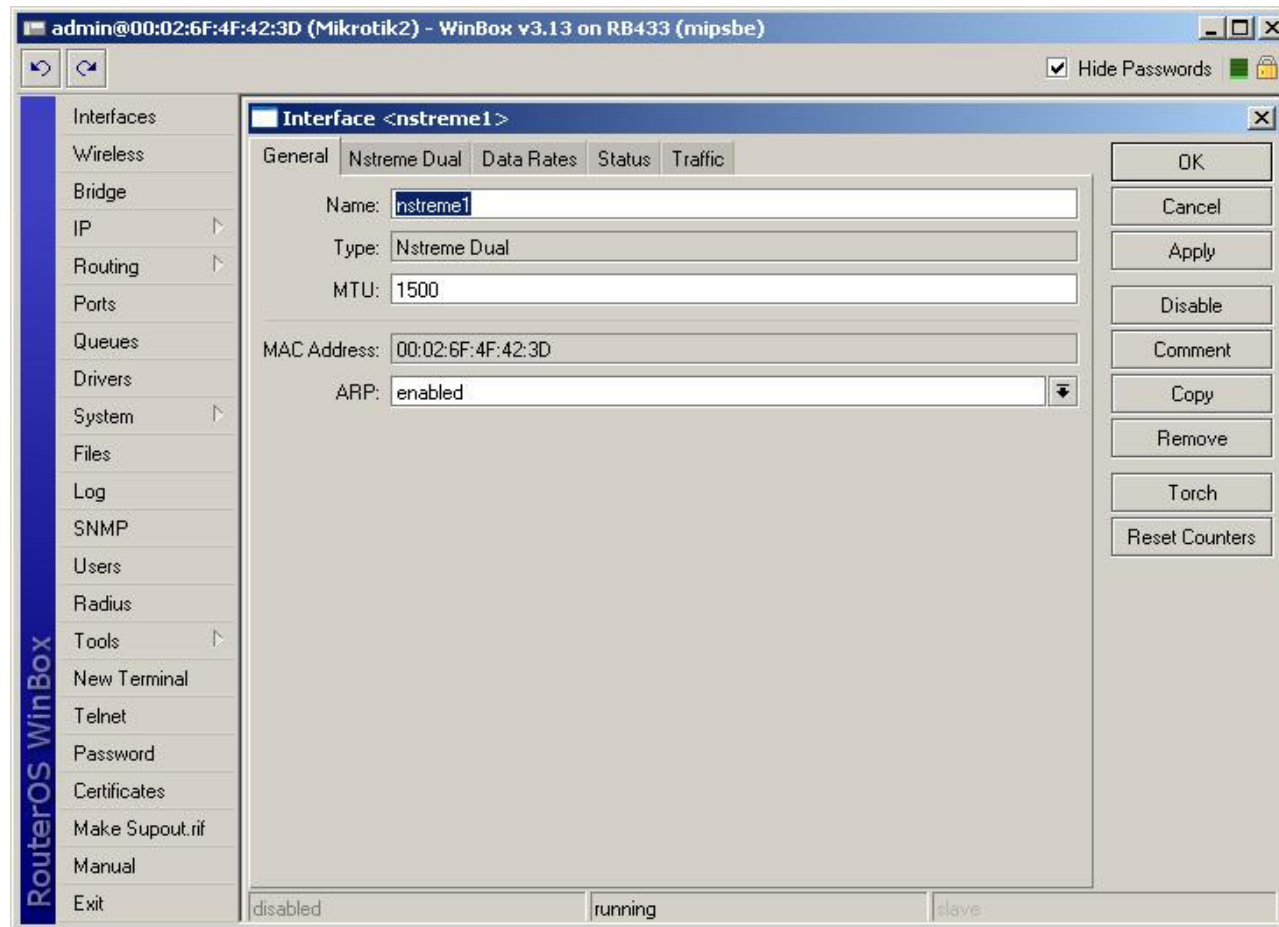
## Mikrotik1



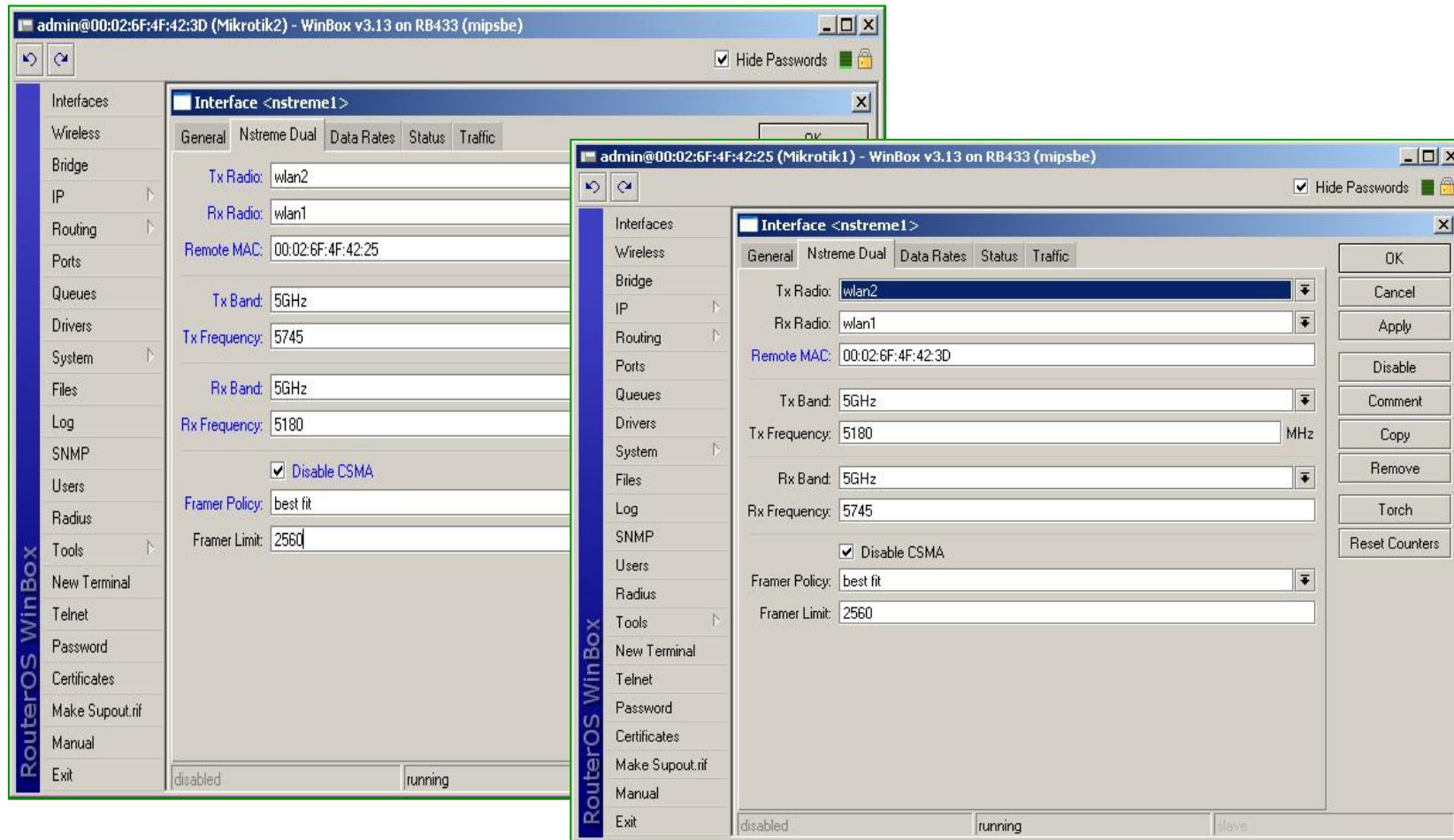


# NSTREME2

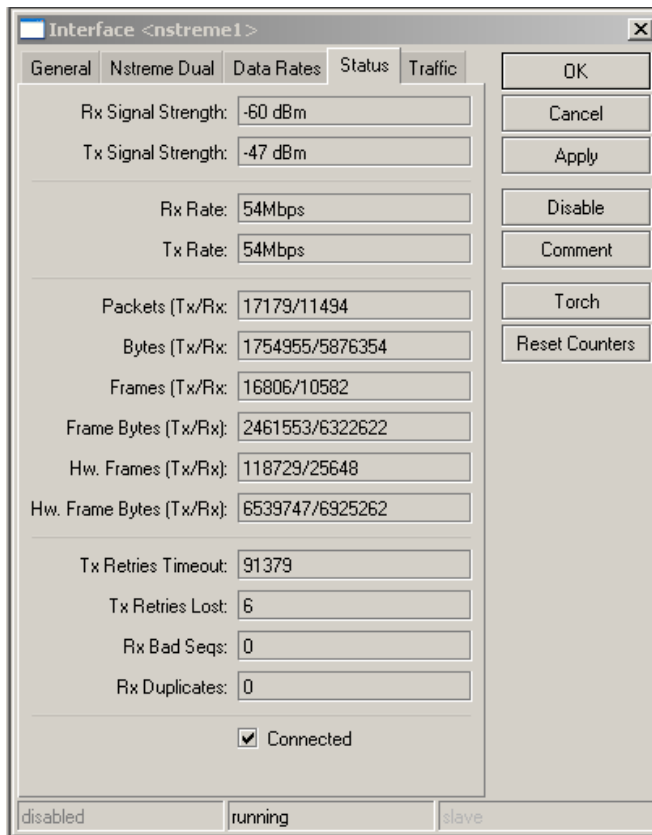
## Mikrotik2



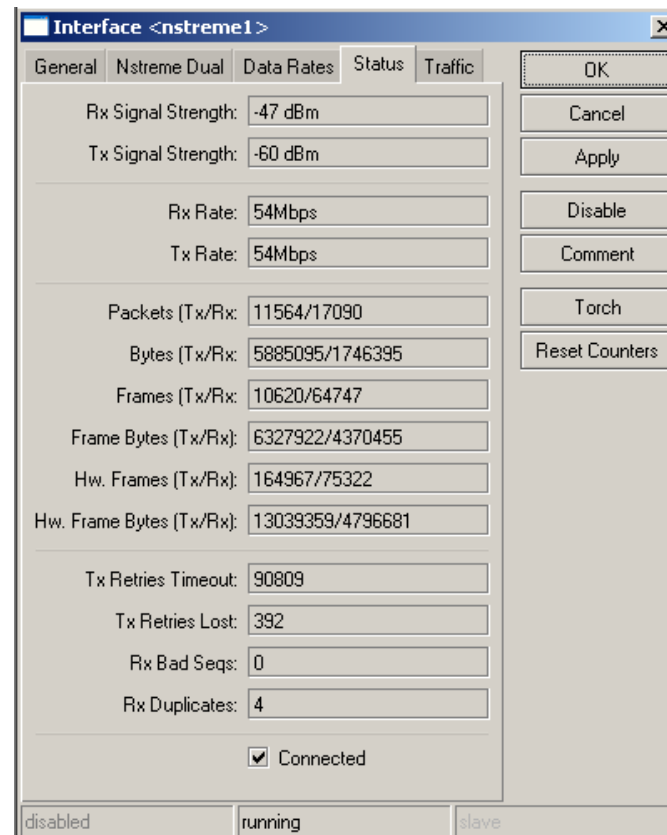
# NSTREME2



# NSTREME2



Parameter	Value
Rx Signal Strength	-60 dBm
Tx Signal Strength	-47 dBm
Rx Rate	54Mbps
Tx Rate	54Mbps
Packets (Tx/Rx)	17179/11494
Bytes (Tx/Rx)	1754955/5876354
Frames (Tx/Rx)	16806/10582
Frame Bytes (Tx/Rx)	2461553/6322622
Hw. Frames (Tx/Rx)	118729/25648
Hw. Frame Bytes (Tx/Rx)	6539747/6925262
Tx Retries Timeout	91379
Tx Retries Lost	6
Rx Bad Seqs	0
Rx Duplicates	0
Connected	<input checked="" type="checkbox"/>



Parameter	Value
Rx Signal Strength	-47 dBm
Tx Signal Strength	-60 dBm
Rx Rate	54Mbps
Tx Rate	54Mbps
Packets (Tx/Rx)	11564/17090
Bytes (Tx/Rx)	5885095/1746395
Frames (Tx/Rx)	10620/64747
Frame Bytes (Tx/Rx)	6327922/4370455
Hw. Frames (Tx/Rx)	164967/75322
Hw. Frame Bytes (Tx/Rx)	13039359/4796681
Tx Retries Timeout	90809
Tx Retries Lost	392
Rx Bad Seqs	0
Rx Duplicates	4
Connected	<input checked="" type="checkbox"/>

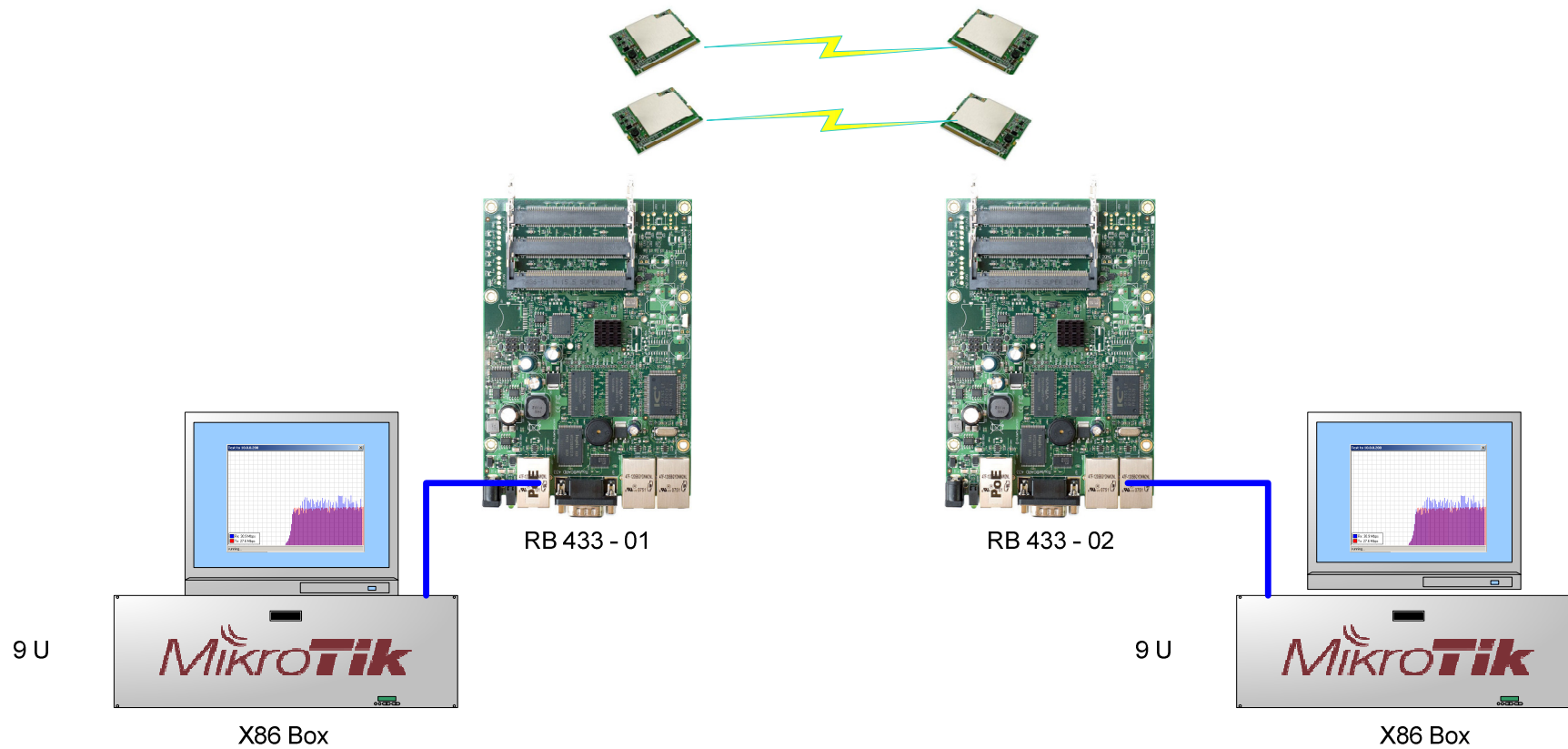
# NSTREME2

## Framer Policy

	<input checked="" type="checkbox"/> Disable CSMA
Framer Policy:	best fit
Framer Limit:	2560

# NSTREME2

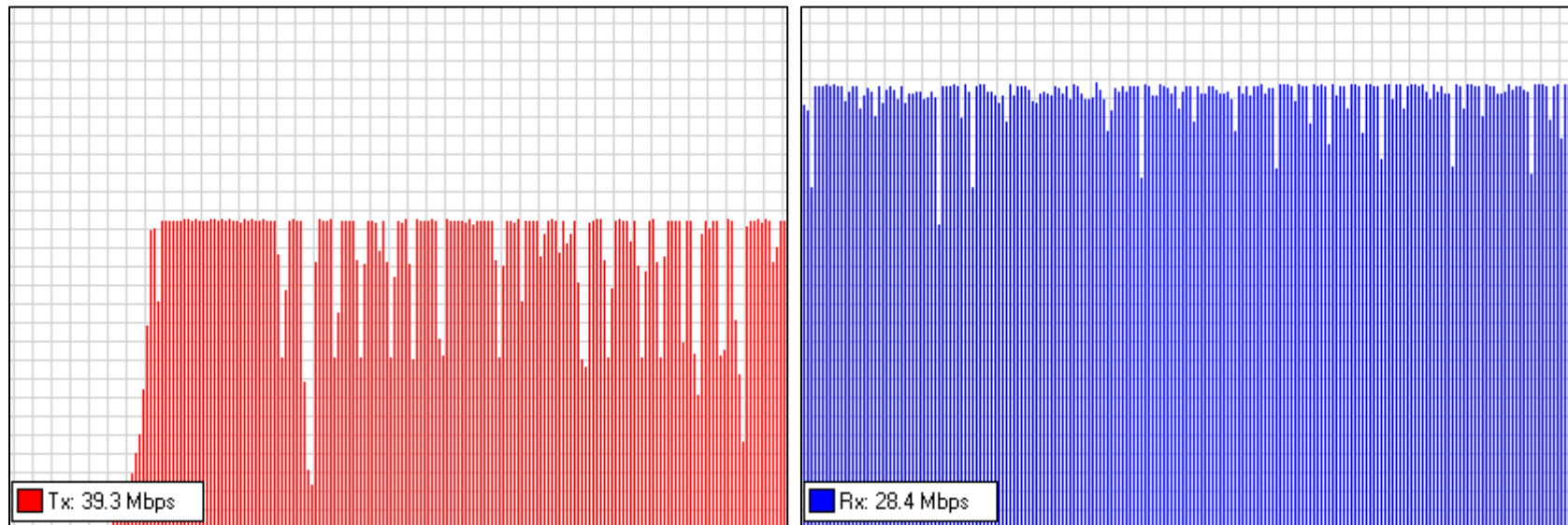
## Laboratório de Testes



# NSTREME2

Teste Unidirecional (Rx) – Protocolo UDP

Teste Unidirecional (Tx) – Protocolo UDP



# NSTREME2

**Teste bidirecional – Protocolo UDP**

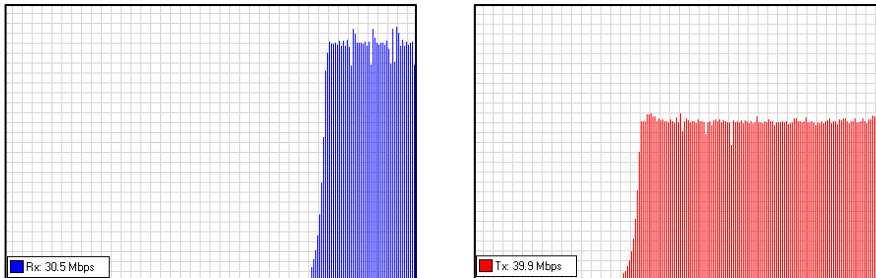
**Média: 33,85 Mbps**

**Teste bidirecional – Protocolo TCP**

**Média: 29,25 Mbps**

# NSTREME2

Framer Policy: **Exact Size**



**Teste bidirecional – Protocolo UDP**

**Média: 35,20 Mbps**

**Teste bidirecional – Protocolo TCP**

**Média: 31,13 Mbps**



# CONCLUSÃO

## ENLACES BASEADOS EM NSTREME 2

- Modulação: OFDM – 802.11a
- Distância: ~30 km

**Média: 33,20 Mbps Full Duplex**

# Fim

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