Lab Topology



Step 1

Connect ether1 of the Mikrotik hEX BDR to a free port of the RENU CPE.

Download winbox application from the Mikrotik Website on link below

https://download.mikrotik.com/routeros/winbox/3.41/winbox64.exe

https://download.mikrotik.com/routeros/winbox/3.41/winbox.exe

Connect your PC to the MikroTik BDR and open the Winbox app

	D4.01.02.01.40.6E											
Connect To: D4	D4:U1:C3:31:48:0F											
Login: admin 🔫 3												
Password:												
Δ	dd/Sot											
	uu/Jei											
Noighbu												
naged weighbo		-11										
Refresh		-										
C Address	4 IP Address	Identity		Version	Board	Uptime						
	0.0.0.0	MikroTik		6.49.11 (s	RB760iGS	00:04:13						
)1:C3:31:48:6F				· · · · ·								

Login to the MikroTik BDR with the password at the back of the router



Remove the default configuration upon login

ľ	RouterOS Default Configuration		
	The following default configuration has been installed on your router:	٠	
Р	Welcome to RouterOS 1) Set a strong router password in the System > Users menu 2) Uggrade the software in the System > Packages menu 3) Enable firewall on untrusted networks		
ł	RouterMode: * WAN port is protected by firewall and enabled DHCP client * Ethernet interfaces (except WAN port/s) are part of LAN bridge LAN Configuration:		ket (p
	IP address 192.168.88.1/24 is set on bridge (LAN port) DHCP Server: enabled; DNS: enabled; WAN (gateway) Configuration:		
	gateway: ether1; 1p4 firewal1: enabled; ip6 firewal1: enabled; NAT: enabled; NAT:		
	Login admin user protected by password		
	You can click on "Show Script" to see the exact commands that are used to add and remove this default configuration.To remove this default configuration click on "Remove Configuration" or click on "OK" to continue		
	NOTE: If you are connected using the above IP and you remove it, you will be disconnected.		
	Remove Configuration Show Script Of	<	

Step 2

Configure the login password for the router, in the format Group@X; where X is group number

System>Password

Change Password		
Old Password:		Password
New Password:	******	Cancel
Confirm Password:	*****	

Step 3

Change the system name for the router to Group-X-BDR; where X is group-number

System>Identity

Identity	
Identity: Group-1-BDR	ОК
	Cancel
	Apply

Service Configurations – IP Summary

Group	P2P Address	Default	Private Space	Public Space
Number		Gateway		
1	137.63.239.66/28	137.63.239.65	192.168.1.0/24	102.34.21.0/29
2	137.63.239.67/28	137.63.239.65	192.168.2.0/24	102.34.21.8/29
3	137.63.239.68/28	137.63.239.65	192.168.3.0/24	102.34.21.16/29
4	137.63.239.69/28	137.63.239.65	192.168.4.0/24	102.34.21.24/29
5	137.63.239.70/28	137.63.239.65	192.168.5.0/24	102.34.21.32/29
6	137.63.239.71/28	137.63.239.65	192.168.6.0/24	102.34.21.40/29
7	137.63.239.72/28	137.63.239.65	192.168.7.0/24	102.34.21.48/29
8	137.63.239.73/28	137.63.239.65	192.168.8.0/24	102.34.21.56/29

P2P Communication to the Internet Service Provider

Step 4

Configure a P2P IP on ether1 to the ISP CPE in the form 137.63.239.6x/28 as shown below.

Ses	sion	setting	sυ	asnboard	
5	6	Safe Mor	de	Session: D4:01:C3:31:	48:71
1	🖌 Qu	ick Set			
2	CA	PsMAN			
	Int	erfaces			
2	Wi	reless			
3	🕻 Bri	dge			
1	PP	Р		(0
	: Sw	itch			· •
•	🎖 Me	sh			
	P IP		P	ARP	
	3 MP	LS	Þ	Accounting	
	₫ IPv	6	Þ	Addresses	
	🛱 Ro	uting	N	Cloud	Address / Network Interface New Address
ş	🖗 Sy	stem	\square	DHCP Client	132,106.1.124 192,106.1.0 Diluge-LAN
4	P Qu	eues		DHCP Relay	Audies. 13/03/23/00/20 5 0K
	📔 File	es		DHCP Server	Network: Cancel
j	🗒 Log	g		DNS	Interface: ether1 🗡 👻 Appy
8	📍 RA	DIUS		Firewall	Disable
	🖌 То	ols		Hotspot	Comment
	Ne Ne	w Termina	I	IPsec	
•	Do	t1X		Kid Control	Copy
	🍃 Pai	rtition		Neighbors	Remove
-	🖹 Ma	ike Supout	t.rif	Packing	enabled
	Ne	w WinBox		Pool	
	🕹 Exi	it		Routes	
				SMB	
1	💷 Wi	ndows	1	SNMP	i item
				SSH	

Verify that you can "Ping" the CPE

Open the Terminal of the MikroTik Router and ping the IP of the CPE (137.63.239.65)

Sadmin@D4:01:C3:31:48:71 (Group-1-BDR) - WinBox (64bit) v6.49.11	on hEX S (mmips) -
Session Settings Dashboard	
Safe Mode Session: D4:01:C3:31:48:71	
X Quick Set	
CAPSMAN	
Interfaces	
💥 Bridge	
the second secon	
T Switch	
°l <mark>o</mark> Mesh	
	Terminal <1>
MPLS P	
₩ IPv6 P	MikroTik RouterOS 6.49.11 (c) 1999-2023 http://www.mikrotik.com/
Routing	[?] Gives the list of available commands
System	command [?] Gives help on the command and list of arguments
	[Tab] Completes the command/word. If the input is ambiguous,
Files	a secona [Tab] gives possible options
	/ Move up to base level
A Task	/command Use command at the base level
Now Terminal	[admin@Group-1=BDR] > ping 137.63.239.65
A Dot1X	0 137.63.239.65 56 64 0ms
	1 137.63.239.65 56 64 0ms 2 137.63.239.65 56 64 0ms
Make Supout rif	3 137.63.239.65 56 64 0ms
New WinBox	4 13/.63.239.65 50 64 0ms
🔣 Exit	sent=6 received=6 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms
	[admin@Group-1-BDR] >
Windows	•

ping 137.63.239.65

ping 1.1.1.1

```
[admin@Group-1-BDR] > ping 1.1.1.1
SEQ HOST SIZE TTL TIME STATUS
0 no route to host
1 no route to host
sent=2 received=0 packet-loss=100%
```

Step 5: Configure Static Routing to your ISP

Configure a default route to the IP of the CPE (137.63.239.65)

IP>Routes>

Annual acturity	Dashboard										
C* Safe Mode	Session D4:01:C3:31:4	3.71									
Chick Set											
CAD-MAN											
			_								
Window											
Birtan		Doute									
I PPP		Deute		1000							
Switch		Route	Nexthops Rules	VRF							
* Mesh							Find	•			
N IP	ARP		Dst. Address	Gateway		Distance Routin	g Mark Pref. Source				
MPLS	Accounting	DAC	137.63.239.64/	bridge-LAN reachable		0	192.168.1.1	00		_	
IPv6	Addresses									- 63	
Routing	Cloud									Ť	
2 System	DHCP Client										
System Cueues	DHCP Client DHCP Relay										
System Cueues	DHCP Client DHCP Relay DHCP Server			Mous Davida							
System C Queues Files	DHCP Client DHCP Relay DHCP Server DNS			New Route							(
System Queues Files Log RADIUS	DHCP Client DHCP Relay DHCP Server DNS Firewall			New Route General Attra	outes						ĸ
System Queues Files Log RADIUS Tools	DHCP Client DHCP Relay DHCP Server DNS Firewall Hotspot			New Route General Attri Dst. Addres	outes 3: 0 0 0 0/0					OK	K
System Queues Files Log RADIUS Tools New Terminal	DHCP Client DHCP Relay DHCP Server DNS Firewall Hotspot IPsec			New Route General Attr Dst. Addres Gatewa	xutes 8: 0 0 0 0/0 7: 137 63.239 65	H	0		•	OK Cano Appl	K cel
System Queues Queues Files Log RADIUS Tools New Terminal Dot1X	DHCP Client DHCP Relay DHCP Server DNS Firewall Hotspot IPsec Kid Control			New Foute General Attri Dst. Addres Gatewa	sultes s: 0.0.0.00 r: 137.63.239.65	-	-0		÷	Ok Cano Appl	K Icel Ply
System Queues Files Log RADIUS Tools New Terminal Dot1X Partition	DHCP Client DHCP Relay DHCP Server DNS Firewall Hotspot IPsec Kid Control Neighbors			New Route General Attri Dst. Addres Galewa Check Galewa	xutes x 0.0.0.00 x 137.63.239.65 x	14 (0		¢	OK Cano Appl Disab	K cel ply
System Queues Queues Files Log RADIUS Tools New Terminal New Terminal Dot1X Partition Make Supout.rif	DHCP Clent DHCP Relay DHCP Server DNS Firewall Hotspot IPsec Kid Control Neighbors Packing			New Fould General Atte Dst. Addes Gatewa Check Gatewa Typ	x 0.0.0.00 x 0.0.0.00 x 1.07.63.239.65 x	-	-0		¢ •	OK Cano Appl Disat Comm	K cel ble nen
System Cueues Cueues Files Log RADIUS Tools New Terminal Dot1X Partition Make Supout if New WinBox	DHCP Client DHCP Server DHCP Server DNS Firewall Hotspot IPsec Kid Control Neighbors Packing Pool	2 2 Roms		Now Route General Attr Dst. Addres Check Galewa Typ Dostance	xutes k 0.0.0.00 f 137.63.239.65 k unicast k	 4 .	0		÷	OK Cano Appl Disat Comm Cop	K cel ible nen Py
System Courses Files Log RADIUS Tools Course Course Course Course Courses New Terminal Dot1X Partition Make Supout rif New WinBox Exit	DHCP Clent DHCP Relay DHCP Server DNS Firewall Hotspot IPsec Kid Control Neighbors Packing Pool Routes	2 2 Auros		New Route General Attr Dst. Addes Check Gatewo Typ Distanc Score	xutes k 0.0.0.00 r 137.63.239.65 r k unicast k 30	4	0		•	OK Cano Appl Disat Comm Cop	K cel blo ner py
System Courses Files Log RADIUS Tools Course Courses New Terminal Dot1X Partition Make Supout.nf New WinBox Exit	DHCP Clent DHCP Relay DHCP Server DNS Frewall Hotspot IPsec Kid Control Neighbors Packing Pool Routes SMB	2 2 8ms		tere Rode General Add Dat Addes Check Gatera Typ Distanc Scope Scope	xutes k (0.0.0.00 r (137.63.230.65 r (unicast k (30) k (30) k (30)	.	0		¢ • •	OK Cano Appl Disat Comm Cop Remo	K cel ble nen Py
System Courses System Courses System Courses System Courses Co	DHCP Clent DHCP Relay DHCP Server DNS Frewall Hotspot IPsec Kid Control Neighbors Pacling Pool Routes SMMP	2 2 dens		Nove Floods Generat Jahn Dal: Addres Cableat Check Gabewa Typ Determine Topp Target Goog	xutes k 00000 1376323965 F x iniciast k 30 10	14) (-	-0		•	Ok Cane Appl Disat Comm Cop Remo	k cel ble nen py
System P Queues Files Log RADIUS Tools P New Terminal Dot1X Partition Make Supout rif New WinBox Exit	DH/D Client DH/D Rolay DH/D Server DNS Firewal Hotspot I Place Kid Control Neightors Pacing Pool Routes SNMP SSH	0 2000		Non Float General Alter Data Addee Check Catewa Typ Datase Scope Taget Scop Taget Scop	NMes (0.0.00 (137.83.238.65 (incast (incast (0 (0 () () () () () () () () () ()	H.	-0		¢ 	OK Cano Appl Disat Comm Cop Remo	K cel ible nen py iove

Verify that the Route is reachable

Route List	t				[□×
Routes	Nexthops Rules	VRF				
+ - '	<pre>X</pre>			F	Find all	₹
	Dst. Address	Gateway	Distance	Routing Mark	Pref. Source	-
AS	▶ 0.0.0.0/0	137.63.239.65 reachable ether1		1		
DAC	137.63.239.64/	ether1 reachable		0	137.63.239.66	6
DAC	192.168.1.0/24	bridge-LAN reachable		0	192.168.1.1	
3 items						

ping 1.1.1.1

MMM MMM KKK TTTTTTTTTTT KKK MMMM MMMM KKK TTTTTTTTTTT KKK MMM MMMM MMM III KKK KKK RRRRR 000000 TTT III KKK KKK MMM MM MMM III KKKKK RRR RRR 000 000 TTT III KKKKK MMM MMM III KKK KKK RRRRR 000 000 TTT III KKK KKK MMM MMM III KKK KKK RRR RRR 000000 TTT III KKK KKK MikroTik RouterOS 6.49.11 (c) 1999-2023 http://www.mikrotik.com/ Gives the list of available commands ?] ommand [?] Gives help on the command and list of arguments [ab] Completes the command/word. If the input is ambiguous, a second [Tab] gives possible options Move up to base level Move up one level command Use command at the base level dmin@Group-1-BDR] > ping 1.1.1.1 SEQ HOST SIZE TTL TIME STATUS 0 1.1.1.1 52 19ms 56 1 1.1.1.1 56 52 19ms 2 1.1.1.1 52 19ms 56 3 1.1.1.1 56 52 19ms 4 1.1.1.1 56 52 19ms

Step 6: Create a bridge and name it "bridgeLAN" and add the necessary ports

Create a bridge for the LAN

Sadmin@D4:01:C3:31	:48:6F (Group-1-BDR) - WinBox (64bit) v6.49.11 on hEX S (mmips)				- 0 ×
Session Settings D	lashboard				
Safe Mode	Session: D4:01:C3:31:48:6F				
Quick Set CAPsMAN CAPsMAN Interfaces Wireless Bridge PPP Switch	0				
°l _o ^o Mesh	Ridne	New Interface	Chakes Traffe		
IP ► Ø MPLS ► IPv6 ► IPv6 ► IPv6 ►	Bridge Ports Port Extensions VLANs MSTIs Port MST Overrides Filters NAT Hosts MDB	Name: Type:	bridgeLAN	3 Cancel Apply	Find FP Tx Packet (p/s) FP Rx F
System N Queues Files		Actual MTU: L2 MTU:		Disable Comment Copy	
Cog		MAC Address: ARP: ARP Timeout:	enabled T	Remove	
New Terminal Oot1X		Admin. MAC Address:	■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■		
Partition Make Supout.rif		Ageing Time:	IGMP Snooping		
Exit	•		DHCP Snooping Fast Forward		
💻 Windows 🗈	0 items out of 6	enabled			•
		onduod	Pointing	3010	J

Add four ports to the bridge i.e. ether2, ether3, ether4, ether5



Step 7: Configure the Private IP Subnet for the LAN (192.168.x.0/24)

Configure your LAN gateway (192.168.x.1/24) on the bridgeLAN interface. Where x is the group number.

IP>address>



Step 8: Configure DHCP for Dynamic allocation of the Private IPs

- Create an IP pool and name it Group-x-pool
- Configure the IPs you want given out by DHCP reserving the first 10 IP addresses

Sadmin@D4:01:C3:3	1:48:6F (Group-1-BDF	R) - WinBox (64bit) v6.49.11 on hEX S (mmips)	- 0	×
Session Settings	Dashboard			
Safe Mode	Session: D4:01:C3:31:	48.6F		
Session Settings Session Settings Safe Mode Cuick Set CAPsMAN Interfaces Wireless Wireless Wireless Wireless Wireless Wireless Wireless Wireless Wireless PPP Wireless Routing Pueueus Files Log Rabitus X Routing Particles Routing Routin	Ashboard Session D401C331 ARP Accounting Addresses Cloud DHCP Clent DHCP Relay DHCP Server DNS Firewall Holopot	48.6F Pool Used Addresses Pool Used Addresses Name / Addresses Next Pool 102 168 1 10-192 168 1 254 Next Pool 102 168 1 10-192 10-192	6 OK Cancel Apply Comment Copy Remove	
New Terminal	IPsec			
Dot1X	Kid Control			
Partition	Neighbors			
Make Supout.rif	Packing			
New WinBox	Pool			
Exit	Routes			
Mindows	SMD			
windows	SSH	0 items		
	Sanicas			
	Settings			
180)	Socks			
5	00010			

- Create a DHCP server and name it **Group-x-server**
- Select the IP pool the server will use it assign IPs and select the bridgeLAN interface for DHCP.



Configure the Private Network under DHCP (192.168.x.0/24), assign it a gateway (192.168.x.1) and also configure DNS addresses (102.34.160.44, 196.43.185.73)

	_																
0	admir	@D4:01:0	:3:3	1:48:6F (Group-1-BDR)	R) - WinB	Box (64b	it) v6.49.11	I on hEX S (mmi	ps)						-	0	×
Se	ssion	Settings	5 [Dashboard													
5	6	Safe Mod	le	Session: D4:01:C3:31:4	48:6F												1
	🖌 Qu	ick Set															
	CA	PsMAN															
	Int	erfaces															
	🗍 Wi	reless													10		
	Bri	dge						_ _									
	PP	P															
1	Sw	itch				DHCP Se	erver 🏒	/									
•	C Me	sh				DHCP	Networks	Leases Option	s Option S	ets Vendor	Classes Alerts	New DHCP Networ	ĸ	A			
	IP	-	\square	ARP		•					Find	Address:	192.168.1.0/24		ŎK		
	Ø MP	LS	\mathbb{P}	Accounting		Addroses		(Ostowou	DN	IC Conjore	Domoio -	Gateway:	192.168.1.1	÷	Cancel		
	쑷 IPv	6	\square	Addresses		Audioss		Gateway	UN	12 241AU2	Domain	Netmask:	24	A	Apply		
	JC Ro	uting	Þ	Cloud									No DNS		Comme	nt	
	Sy Sy	stem	Þ	DHCP Client								DNS Servers:	196.43.185.73	÷.	Conv	<u> </u>	
	🗣 Qu	eues		DHCP Relay	2								102.34.160.44	9 🔹	Сору		
	File	es :		DHCP Server								Domain:			Remove	<u> </u>	
	🗐 Lo	9		DNS								WINS Servers		\$	8		
	N RA	DIUS		Firewall								NTP Servers					
	To To	ols		Hotspot								CAPS Managers		↓			
	Ne Ne	w Terminal		IPSec Kid Cankel								Next Committee Street		• • • • • • • • • • • • • • • • • • •			
	97 Do	tix		Kid Control								Next Server:		•			
	Pa Ma	ko Supcut	rif	Packing								Boot File Name:		•			
	No No	w WinBox	.111	Packing								DHCP Options:		÷			
		t the second		Routes		•					٠	DHCP Option Set:		•			
				SMB		0 items											
	wi	ndows	Þ	SNMP													
	_ ***			SSH													

- Confirm that your computer is obtaining IP addresses dynamically according to the DHCP configuration.
- > Open the terminal on your computer (Windows + R); type (cmd) and press enter.
- > On the terminal, type **ipconfig /all**

ipconfig /all

PS C:\Users\mugam> ipconfig /all	
Windows IP Configuration	
Host Name	. : RENU-NO-MUGAMBE . : . : Hybrid . : No . : No . : renu.ac.ug net.renu.ac.ug
Ethernet adapter Ethernet 5:	
Connection-specific DNS Suffix Description	<pre>. : renu.ac.ug . : Realtek USB GbE Family Controller . : AC-91-A1-8E-F3-D9 . : Yes . : Yes . : fe80::4a3e:abf7:3afe:a12f%8(Preferred) . : 192.168.1.253(Preferred) . : 255.255.255.0 . : Wednesday, 30 April 2025 09:41:41 . : Wednesday, 30 April 2025 17:41:40 . : 192.168.1.1 . : 192.168.1.1</pre>
DHCPV6 IAID	.: 954050555 :: 00-01-00-01-2F-93-9B-83-F0-D4-15-B2-79-EC :: fe80::4a3e:abf7:3afe:a12f%8 127.7.7.5
NetBIOS over Tcpip	. : Enabled earch List :
	renu.ac.ug net.renu.ac.ug

Step 9: Configure NAT for the Private IPs (192.168.x.0/24) to the public IPs (102.34.21.x/29).





Confirm that the NAT rule is working by issuing ping 1.1.1.1 source-address 192.168.x.1

ping 1.1.1.1 source-address 192.168.x.1

admin@MikroTik]	>					
admin@MikroTik]	>					
admin@MikroTik]	>					
admin@MikroTik]	> pin	g 1.1.1.1	src-address=192.168	.1.1		
SEQ HOST			SIZE	TTL	TIME	STATUS
0 1.1.1.1			56	52	63ms	
1 1.1.1.1			56	52	62ms	
2 1.1.1.1			56	52	62ms	
3 1.1.1.1			56	52	62ms	
4 1.1.1.1			56	52	62ms	

- After verifying that you can reach the internet from the router, its time to confirm that you can reach the internet from your laptop.
- > Issue the following commands on your computer terminal

ping 8.8.8.8

ping google.com

nslookup google.com

Open any browser on you computer and perform the following speed tests <u>https://pfs-raxio.renu.ac.ug/speedtest/</u> fast.com

speedtest.net

https://speed.cloudflare.com/

Also download PingPlotter from the url below <u>https://www.pingplotter.com/download/</u>

Step 10: Connecting Network equipment to the network

- Congratulations for reaching this far and configuring your own router to connect you to the global network
- > Now connect the provided access point, and confirm that it is picking an IP
- Confirm you can ping the AP's IP both on the router's terminal and on your computer's terminal.
- Repeat the procedure with any other peripherals available like printers, VoIP phones if any, cameras etc

Step 11: Questions from Participants and Troubleshooting Tips

- ➢ Loose cables
- ➢ Not picking an IP
- DNS not resolving??
- Can ping but can't browse
- > AP not picking an IP
- > Any other issues from the Participants