

UDP Packet Switching Demo Instruction

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UDP Packet Switching Demo Instruction

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This document provides step-by-step instructions for running a UDP Packet Switching demo on the KCU116 development board. The demo showcases the switching of incoming UDP packets using tCAM-IP, focusing on packet processing similar to Access Control Lists (ACLs) but specifically targeting UDP traffic. This allows users to gain a deeper understanding of how tCAM-IP can be used to filter and switch UDP packets across a 10Gbps Ethernet connection with four channels.

All configurations for this demo can be easily managed through the serial console interface. This instruction will guide you through setting up the test environment, running the demo, and interpreting the results.

1 Environment Setup

To operate tCAM-IP demo, please prepare following test environment.

- 1) FPGA development board (KCU116 development board)
- 2) Test PC with 10 Gigabit Ethernet card.
- 3) Micro USB cable for JTAG connection between FPGA board and Test PC.
- 4) Micro USB cable for UART connection between FPGA board and Test PC.
- 5) 10Gb Ethernet cable (SFP+ to SFP+).
- 6) Vivado tool for programming FPGA installed on Test PC.
- 7) Serial console software such as TeraTerm installed on PC. The setting on the console is Baudrate=115,200, Data=8-bit, Non-parity and Stop=1.
- 8) Demo configuration file (To download this file, please visit our web site at www.design-gateway.com).



Figure 1 tCAM-IP demo on KCU116 board



2 PC Setup

Before running demo, please check the network setting on PC. Ethernet setting is shown as follows.

2.1 IP Setting

Ethernet 8 Properties ×	Internet Protocol Version 4 (TCP/IPv4) Properties					
letworking Sharing	General					
Connect using: 10-Gb LAN connection Intel(R) Ethemet Controller X710 for 10GbE SFP+	You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.					
<u>C</u> onfigure	O <u>O</u> btain an IP address automatically					
This connection uses the following items:	Use the following IP address:					
Glient for Microsoft Networks	IP address: 192.168.7.25					
Trie and minter Sharing for Microsoft Networks Pocap Packet Driver (NPCAP)	Subnet mask: 255 . 255 . 255 . 0					
QoS Packet Scheduler Control Control Control (CCP/IPv4)	Default gateway:					
Microsoft Network Adapter Multiplexor Protocol Microsoft LLDP Protocol Driver	Obtain DNS server address automatically					
< >	Use the following DNS server addresses:					
Install Uninstall Properties	Preferred DNS server:					
Description	Alternate DNS server:					
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.	Valjdate settings upon exit Ad <u>v</u> anced					
OK Cancel	OK Cancel					

Figure 2 Setting IP address for PC

- 1) Open Local Area Connection Properties of 10 Gb connection, as shown in the left window of Figure 2.
- 2) Select "TCP/IPv4" and then click Properties.
- 3) Set the IP addresses to 192.168.7.25, 192.168.7.20, 192.168.7.30, and 192.168.7.35 with a subnet mask of 255.255.255.0, as shown in the right window of Figure 2.



2.2 Speed and duplex settings



Figure 3 Set Link Speed = 10 Gbps

- 1) On Local Area Connection Properties window, click "Configure", as shown in Figure 3.
- 2) On Advanced Tab, select "Speed and Duplex". Set the value to "10 Gbps Full Duplex" for running 10 Gigabit transfer test, as shown in Figure 3.

2.3 Network properties settings

Some of network parameter settings may affect network performance. The example of network properties setting is as follows.

1) On "Interrupt Moderation" window, select "Disabled" to disable interrupt moderation which would minimize the latency during transferring data, as shown in Figure 4

Intel(R) Ethernet Controller X710 for 10GbE SFP+ Properties $\qquad \qquad \qquad$							
General	Advanced	Driver	Details	Events	Power Mana	gement	
The folk the prop on the r	owing propert perty you wan ight.	ties are av t to chang	ailable fo e on the	orthis ne eleft, an	etwork adapter. d then select its /alue:	Click s value	
Enable Energy Row C Interru Interru IPv4 C Jumbo Large : Large : Large : Large : Large : Maximu Maximu	PME PME Efficient Ethion ontrol to Moderation hecksum Offi hecksum Offioad Send Offioad Send Offioad Send Offioad ate on Interfac v Administered um Number of um Number of	emet Rate oad V2 (IPv4) V2 (IPv6) sce Down I Address it f RSS Proof f RSS Que			Disabled Disabled Enabled		~
				[ОК	Can	icel

Figure 4 Interrupt Moderation

2) On "Interrupt Moderation Rate" window, set the value to "OFF", as shown in Figure 5.

Intel(R) E	thernet Con	troller X	710 for	10GbE S	SFP+ Pro	perties		×
General	Advanced	Driver	Details	Event	s Powe	r Manage	ement	
The foll the prop on the r	owing propert perty you wan ight.	ies are a t to chan	vailable ge on th	for this r ie left, a	etwork and then s	dapter. C elect its v	lick value	
Property	y:				Value:			
Enable Energy Flow C Interru IPv4 C Jumbo Large : Link S Locally Log Lir Maximi	PME Pfficient Ethiontrol pt Moderation pt Moderation pt Moderation hecksum Offil Packet Send Offiload Send Offiload Send Offiload v Administered nk State Ever um Number of um Number of	ernet Oad V2 (IPv4 V2 (IPv6 ice Down I Address t f RSS Pro f RSS Qu			Off			~
					OK		Cano	el

Figure 5 Interrupt Moderation Rate

3) On "Jumbo packet" window, set the value to "9014 Bytes", as shown in Figure 6.

Intel(R) Ethernet Controller X710 for 10GbE SFP+ Properties							×
General	Advanced	Driver	Details	Events	Power Mana	gement	
The foll the prop on the r Property Enable Energy Row C Interru Interu Interru Interru Interru Interru Interru Interru Interru Interru	owing propert perty you wan ight. PME PME Pfficient Eth- iontrol pt Moderation pt Moderatio	ies are a t to chan emet Rate oad V2 (IPv4 V2 (IPv6 ice Down I Address it f RSS Pro f RSS Qu)))))))))))))))))))	or this ne e left, and V	twork adapter. d then select its alue: 9014 Bytes 4088 Bytes 9014 Bytes Disabled	Click s value	
					OK	Cano	el 🛛



4) On "Receive Buffers" window, set the value to the maximum value, as shown in Figure 7.

Intel(R) E	thernet Con	troller X	710 for	r 1(OGbE SF	P+ P	ropertie	es		\times
General	Advanced	Driver	Detail	s	Events	Pov	ver Man	ageme	ent	
The foll the prop on the r	owing propert berty you wan ight.	ties are a It to chan	vailable ge on t	e fo the	rthis ne left, and	twork I then	adapter select if	r. Click ts valu	e	
Property	<i>r</i> :				V	alue:				
Link Si Locally Log Lir Maximu Packet Preferr Receiv RSS In RSS In Speed TCP C TCP C	ate on Interfa Administered k State Ever um Number of t Priority & VL ed NUMA no re Buffers re Side Scalir ase Processo ad balancing & Duplex hecksum Offl hecksum Offl	ace Down d Address ht f RSS Pri f RSS Qu AN de profile oad (IPvi oad (IPvi	n pocessi ieues r 4) 5)	*		4096				
					E	0	K	(Cance	el

Figure 7 Receive Buffers

5) On "Transmit Buffers" window, set the value to the maximum value, as shown in Figure 8.

Intel(R) E	thernet Con	troller X	710 for 1	OGbE SFI	P+ Propertie	s	×
General	Advanced	Driver	Details	Events	Power Mana	agement	
The foll the prop on the r	owing propert perty you wan ight.	ies are a t to char	vailable fo ige on the	orthisnet eleft, and	work adapter. then select it:	Click s value	
Property	y:			Va	lue:		
Maximu Packe Preferr Receiv RSS B RSS Id Speed TCP C TCP C TCP C UDP C UDP C VLAN	um Number of t Priority & VL ed NUMA no- ve Buffers ve Side Scalir lase Processo vad balancing & Duplex hecksum Offil hecksum Offil hecksum Offil hecksum Offil hecksum Offil hecksum Offil hecksum Offil	FRSS Qu AN de rr Numbe profile oad (IPv oad (IPv oad (IPv	r 4) 6) *		096		
					ОК	Cano	;el

Figure 8 Transmit buffers



3 UDP Packet Switching Demo setup

- 1) Make sure the power switch is off and connect the power supply to KCU116 development board.
- 2) Connect 10Gb SFP+ cable from KCU116 board to PC.
 - i) SFP0 to NIC with IP 192.168.7.25
 - ii) SFP1 to NIC with IP 192.168.7.20
 - iii) SFP2 to NIC with IP 192.168.7.35
 - iv) SFP3 to NIC with IP 192.168.7.30
- 3) Connect USB cable between PC to JTAG micro USB port.
- 4) Power on the system.
- 5) Open Vivado Hardware Manager to program FPGA by following steps.
 - i) Click open Hardware Manager.
 - ii) Click "Auto Connect" to connect with the board.
 - iii) Select FPGA device to program bit file.
 - iv) Click Program device.
 - v) Click "..." to select program bit file.
 - vi) Click Program button to start FPGA Programming.

Vivado 2021.1	HARDWARE MANAGER
ile Flow Iools Window Help	ii) Open target -> Auto Conne No hardware target is open. Open target
ML Editions	Hardware
Quick Start	Open New Target
	HARDWARE MANAGER - localhost/xilinx_tcf/Digilent/210308AB9D59
Create Project >	Hardware ? _ 🗆 🗠 🗙 MIG - MIG_1
Open Project >	
Open Example Project >	Name Status
	✓ ■ localhost (1) iii) Select FPGA device to program bit file ✓ ■ * xilinx tc// iii t/21030€ Open
	Citie E
Tacks	I SysMon (S Program Device
TASKS	Verify Device
Manage IP >	C Refresh Device iv) Click Program device
Open Hardware Manager >	A Program Device
Vivado Store >	Coloris Distance and the Change of the second structure of the second
7	hardware device. You can optionally select a debug probes
	tile that corresponds to the debug cores contained in the bitstream programming file.
Loorning Contor	V) Click "" to select program bit file
Learning Center	Bitstream file: D:/download/UDPSwitching.bit 🚳
Documentation and Tutorials >	Debug probes file:
Quick Take Videos >	vi) Click Program button to start
What's New in 2021.1 >	
	? Program Cancel

Figure 9 Program Device



4 Serial Console

Users can configure various parameters and manage the UDP packet switching application directly through the serial console. The available commands allow users to control access list, filter UDP packets, and monitor network status. The UDP packet switching commands and their usages are displayed as shown in Figure 10. Detailed information about each command is described in topic 5.

```
LL10GEMAC Version = 0x00008884
 TCAM
          Version = 0 \times 00002980
_____
          UDP Packet Switching
 _____
Available commands:
      showlist : Display all access list entries.
             showlist
      addlist : Add a access list entry.
             addlist <actions> <protocol> <ip-addr> [-m ip-mask] [-p port]
     movelist : Move a access list entry by list number.
movelist <list number> -d [number] | -u [number]
   clearlist : Remove all access list entries.
             clearlist
    netstatus : Display the current status of all network interfaces.
             netstatus
    configmode : Configure the comparison parameter to use the source or destination network parameter.
             configmode <src|des>
Use '<command> --help' for detailed usage of a specific command.
```



5 Command detail

5.1 Show Access List

command> showlist

This command displays all access list entries, including detailed information, for UDP packet switching. The entries are prioritized based on their list numbers, with lower numbers taking precedence.

5.2 Add Access List Entry

command> addlist <action> <protocol> <ip-addr> [-m ip-mask] [-p port]

This command adds a new entry to the access list. Users must specify the active channels in binary format in the action field, protocol (TCP, UDP, ICMP), IP address in ip-addr, optional wildcard mask for the IP address with -m, and port number (TCP, UDP) with -p if required.



Figure 11 Example of the showlist and addlist command usage



Move Access List Entry 5.3

command> movelist <list number> -d [number] | -u [number]

This command moves an access list entry up or down in the list. Use the -d option to move down and -u to move up by the specified number of positions.

>> sh	lowlist				
Num	Action	Protocol	IP Address	Port	
1	1000	UDP	192.168.7.30	4433	
2	0100	TCP	192.168.7.35	ANY	
3	0010	ICMP	192.168.7.20	ANY	
4	0001	IP	192.168.7.XXX	ANY	
>> sh	owlist	Initializ	eu anu access IIS	upuateu.	
Num	Action	Protocol	IP Address	Port	
1	0100	ТСР	192.168.7.35	ANY	
2	0010	ICMP	192.168.7.20	ANY	
3	1000	UDP	192.168.7.30	4433	
4	0001	IP	192.168.7.XXX	ANY	



5.4 Remove Access List Entry

command> removelist <list number>

This command removes a specific access list entry based on its list number.

>>	showlis			
N	um Acti	n Protocol	IP Address	Port
	1 0100 2 0010	TCP ICMP	192.168.7.35 192.168.7.20	ANY ANY
	3 1000 4 0001	UDP IP	192.168.7.30 192.168.7.XXX	4433 ANY
>> Su	removel: ccess: T	st 2 AM initiali	zed and access lis	t updated.
>>	showlis			
N	um Acti	n Protocol	IP Address	Port
	1 0100 2 1000	TCP UDP	192.168.7.35 192.168.7.30	ANY 4433
	3 0001	IP	192.168.7.XXX	ANY

Figure 13 Example of the removelist command usage

5.5 **Clear All Access List Entries**

command> clearlist

This command removes all entries from the access list, clearing all previously configured rules from the system.



Figure 14 Example of the clearlist command usage



5.6 Show Network Status

command> netstatus

This command displays the current status of all ethernet interfaces card.

>> netStatus	
Interface Name	Status
Ethernet 0	Link Up
Ethernet 1	Link Up
Ethernet 2	Link Up
Ethernet 3	Link Up



5.7 Configure Comparison Mode

command> configmode <src|des>

This command configures the comparison mode to use either the source (src) or destination (des) network parameter for filtering and switching UDP packets.



Figure 16 Example of the configmode command usage

6 Software UDP Client and Server for Test

This section details the software components used for testing UDP packet transmission and reception, implemented in Python. The demo utilizes two distinct programs: a UDP client and a UDP server.

6.1 UDP Client

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The UDP client is designed to send UDP packets to a specified IP address and port. It can be configured with several options, including the delay between packets, the number of packets to send, and the size of each packet. The client is executed with the following command-line arguments:

- Client IP : The IP address of the client (e.g., 192.168.7.25).
- d <delay> : The delay between packets in seconds (default: 0).
- n <loop> : The number of packets to send (default: 100).
- - s <size> : The size data to extend (default: 0).



Figure 17 Example of the UDP client displaying help options

Additional Client Configuration

In addition to the above options, the UDP client allows users to specify multiple server targets. Users can configure the "server" variable in the "Client.py" file to include a list of server IP addresses and ports, enabling the client to send packets to multiple servers. Users can modify the server IP addresses and ports, and add or remove server targets as needed.

For example, the "server" variable can be set as follows:

27	# Server address
28	server = [("192.168.7.20", 4433),
29	("192.168.7.30", 4433),
30	("192.168.7.35", 4433),
31	···· ···· ·]

Figure 18 Example of the configmode command usage

6.2 UDP Server

The UDP server listens for incoming UDP packets on all IP addresses and a specified port. It is configured with the following command-line argument:

• Server IP:Port : The server's IP address and port (e.g., 192.168.7.25:4433).

D:\Software>py Server	r.py -h
usage: UDP Server [-1	h] <server ip:port=""></server>
UDP Server listen to	all IP and spacific port
positional arguments	:
<server ip:port=""></server>	Server address and port (e.g. 192.168.7.25:4433)
options: -h,help s	show this help message and exit

Figure 19 Example of the UDP server displaying help options

The client and server are both implemented in Python, providing a straightforward and flexible setup for demonstrating UDP packet switching.



7 UDP Packet Switching Behavior Demonstration

In this demonstration, the UDP packet switching behavior will be observed after configuring the access list and switching to destination mode. The UDP client will send packets through the interface card with IP "192.168.7.25", and the system will route these packets to the correct destination servers based on the access list.

7.1 Add Access List Entry and Switch to Destination Mode

First, define the access list to route packets to specific servers, with each entry corresponding to a different server IP address and port. After configuring the access list, switch the system to destination mode to enable packet routing based on the destination IP addresses.



Figure 20 Example of adding access list entry and switching to destination mode

7.2 View All Entries in Access List

After defining the lists, verify the configuration using the showlist command.

>> sh	owlist			
Num	Action	Protocol	IP Address	Port
1	1000	UDP	192.168.7.30	4433
2	0100	UDP	192.168.7.35	4433
3	0010	UDP	192.168.7.20	4433
4	0001	UDP	192.168.7.25	4433

Figure 21 Example of displaying all configured access list

7.3 Open UDP Server to Listen on Port 4433

To receive the UDP packets, the server needs to run by excusing "server.py" with ip address and port of ethernet interface.

⊠ py ×			🖾 ру 🛛 🗙		Δ
D:\Software>p Listening for	y Server.py 192.168.7.25:4433 incoming data on port 4433. Press Ctrl+C to stop.		D:\Software>; Listening for]	ny Server.py 192.168.7.35:4433 incoming data on port 4433. Press Ctrl+C to stop.	
🖾 ру 🛛 🗙		+ 🗆 🛆 …	🖾 ру 🛛 🗙		<u>A</u>
D:\Software>p Listening for	y Server.py 192.168.7.20:4433 incoming data on port 4433. Press Ctrl+C to stop.		D:\Software>; Listening for]	ny Server.py 192.168.7.30:4433 ∙ incoming data on port 4433. Press Ctrl+C to stop.	

Figure 22 Example of opening UDP servers listening on port 4433 for all four channels



7.4 Packet Transmission

Configure the UDP client to send packets to the following servers. Open the "Client.py" script and update the "server" variable as shown below.



Figure 23 Example of updating the "server" variable in UDP client

Run the UDP client with the following command to start sending packets through the interface with IP 192.168.7.25.

D:\Software>py Client.py 192.168.7.25 Success : send 100 packet with delay 0 Second.	
	l ,

Figure 24 Example of command to start UDP client

7.5 Result

From the demonstration, it can be observed that the UDP client sends data to UDP servers at 192.168.7.30, 192.168.7.35, and 192.168.7.20. Each UDP server successfully receives and displays the data. Figure 26 show the Wireshark capture, showing that each ethernet interface card only receives packets that match its own IP address. This confirms that the packet switching system correctly routes the UDP packets according to the configured access list.

⊠ py ×		⊠ py ×	A
D:\Software>py Server.py 192.168.7.25:4433 Listening for incoming data on port 4433. Press Ctrl+C to stop.		recv from ip=192.168.7.25:25394 data='msg 79 to 192.168.7.35' recv from ip=192.168.7.25:59195 data='msg 80 to 192.168.7.35' recv from ip=192.168.7.25:59195 data='msg 81 to 192.168.7.35' recv from ip=192.168.7.25: 5919 data='msg 82 to 192.168.7.35' recv from ip=192.168.7.25: 7956 data='msg 83 to 192.168.7.35' recv from ip=192.168.7.25: 37956 data='msg 84 to 192.168.7.35' recv from ip=192.168.7.25: 37956 data='msg 84 to 192.168.7.35' recv from ip=192.168.7.25: 2752 data='msg 85 to 192.168.7.35' recv from ip=192.168.7.25: 2752 data='msg 85 to 192.168.7.35' recv from ip=192.168.7.25: 93 data='msg 88 to 192.168.7.35' recv from ip=192.168.7.25: 93 data='msg 88 to 192.168.7.35' recv from ip=192.168.7.25: 290 data='msg 89 to 192.168.7.35' recv from ip=192.168.7.25: 290 data='msg 91 to 192.168.7.35' recv from ip=192.168.7.25: 290 data='msg 92 to 192.168.7.35' recv from ip=192.168.7.25: 290 data='msg 93 to 192.168.7.35' recv from ip=192.168.7.25: 2590 data='msg 93 to 192.168.7.35' recv from ip=192.168.7.25: 590 data='msg 93 to 192.168.7.35' recv from ip=192.168.7.25: 5306 data='msg 95 to 192.168.7.35' recv from ip=192.168.7.25: 5305 data='msg 95 to 192.168.7.35' recv from ip=192.168.7.25: 65135 data='msg 95 to 192.168.7.35' recv from ip=192.168.7.25: 65135 data='msg 95 to 192.168.7.35' recv from ip=192.168.7.25: 5305 data='msg 95 to 192.168.7.35' recv from ip=192.168.7.25: 74033 data='msg 95 to 192.168.7.35' recv from ip=192.168.7.25: 7403 data='msg 95 to 192.168.7.35'	
⊠ py ×	Δ…	⊠ py × +	□
recv from ip=192.168.7.25: 6075 data='msg 79 to 192.168.7.20' recv from ip=192.168.7.25:10933 data='msg 80 to 192.168.7.20' recv from ip=192.168.7.25:10634 data='msg 81 to 192.168.7.20' recv from ip=192.168.7.25: 1144 data='msg 82 to 192.168.7.20' recv from ip=192.168.7.25: 5336 data='msg 83 to 192.168.7.20' recv from ip=192.168.7.25:6505 data='msg 85 to 192.168.7.20' recv from ip=192.168.7.25:6505 data='msg 85 to 192.168.7.20' recv from ip=192.168.7.25:6505 data='msg 85 to 192.168.7.20' recv from ip=192.168.7.25:6269 data='msg 85 to 192.168.7.20' recv from ip=192.168.7.25:13246 data='msg 85 to 192.168.7.20' recv from ip=192.168.7.25:13246 data='msg 85 to 192.168.7.20' recv from ip=192.168.7.25:13246 data='msg 89 to 192.168.7.20' recv from ip=192.168.7.25:855 data='msg 99 to 192.168.7.20' recv from ip=192.168.7.25:855 data='msg 99 to 192.168.7.20' recv from ip=192.168.7.25:85785 data='msg 99 to 192.168.7.20' recv from ip=192.168.7.25:12090 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:12090 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:12090 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:1255585 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:1255585 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:1255583 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:1255585 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:1255583 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:12555583 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:125555 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:15555 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:15555 data='msg 95 to 192.168.7.20' recv from ip=192.168.7.25:1755 data='msg 95 to 192.168.7.20'		recv from ip=192.168.7.25:36045 data='msg 79 to 192.168.7.30' recv from ip=192.168.7.25:28899 data='msg 80 to 192.168.7.30' recv from ip=192.168.7.25:44108 data='msg 81 to 192.168.7.30' recv from ip=192.168.7.25:61583 data='msg 82 to 192.168.7.30' recv from ip=192.168.7.25:53611 data='msg 83 to 192.168.7.30' recv from ip=192.168.7.25:59412 data='msg 84 to 192.168.7.30' recv from ip=192.168.7.25:59412 data='msg 85 to 192.168.7.30' recv from ip=192.168.7.25:5944 data='msg 85 to 192.168.7.30' recv from ip=192.168.7.25:59549 data='msg 85 to 192.168.7.30' recv from ip=192.168.7.25:59549 data='msg 85 to 192.168.7.30' recv from ip=192.168.7.25:51959 data='msg 85 to 192.168.7.30' recv from ip=192.168.7.25:2195 data='msg 89 to 192.168.7.30' recv from ip=192.168.7.25:21305 data='msg 99 to 192.168.7.30' recv from ip=192.168.7.25:24827 data='msg 99 to 192.168.7.30' recv from ip=192.168.7.25:2572 data='msg 91 to 192.168.7.30' recv from ip=192.168.7.25:2858 data='msg 94 to 192.168.7.30' recv from ip=192.168.7.25:288 data='msg 95 to 192.168.7.30' recv from ip=192.168.7.25:49247 data='msg 95 to 192.168.7.30'	

Figure 25 Example of UDP servers receiving data from UDP client



UDP Packet Switching

Capituring	from Ethernet 5						d Cap	shaing from Ethaneset 6					
File Edit 1	New Co Capture Analyze Statistica	Telephony Wireland 1	tools Help				FBA 1	Edit, View Go Capture Analyze	Statistics Turkiphony Window Tool				
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M leatrons	4433					(M 1) *	Millioop	(porte reeo)					
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041	192.108.7.25	192.108.7.35	11/5	4433 UDP	11/3 + 4453 Lenz22			400 192.108.7.25	192.198.7.35	58555	6433 UDP	58555 + 4453 Lenz22	
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846	192 168 7 25	192 168 7 39	61858	4433 UDP	61959 + 4433 pn=22			495 192 168 7 25	192 168 7 35	17784	4433 UDP	17784 a 4433 Lan-22	
847	102 168 7 25	102 160 7 35	60017	4413 100	60817 + 4413 (one22			405 192 168 7 25	102 168 7 35	60104	4433 100	60506 - 4433 Later22	
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849	192.168.7.25	192.168.7.39	\$\$772	4413 UDP	55772 + 4433 Lene22			ARE 192.168.7.25	192, 168, 7, 35	59185	4413 LDP	59185 + 4433 Lan+22	
850	192.168.7.25	192.168.7.35	18737	4433 UDP	10737 + 4433 Len+22			409 192,168,7,25	192.168.7.35	5919	4433 UDP	5919 - 4433 Len+22	
851	192.168.7.25	192.168.7.20	12898	4433 UDP	12090 + 4433 Len+22			410 192,168.7.25	192.168.7.35	38987	4433 UDP	38987 + 4433 Len+22	
852	192.168.7.25	192,168,7,30	17155	4433 UDP	17155 + 4433 Lene22			411 192.168.7.25	192.168.7.35	7954	6433 UDP	7956 -+ 4433 Lenu22	
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854	192.168.7.25	192.168.7.20	50384	4433 UDP	50384 + 4433 Len=22			415 192.168.7.25	192.168.7.35	33292	4433 UDP	33192 - 4433 Len=22	
855	192.168.7.25	192,168,7,30	2858	4433 UDP	2858 → 4433 Lenx22			414 192,168.7.25	192,168,7,35	2752	4433 UDP	2752 - 4433 Lens22	
854	192.168.7.25	192.168.7.35	65135	4433 UDP	65135 + 4433 Len=22			415 192.168.7.25	192.168.7.35	59948	4433 UDP	59948 - 4435 Len=22	
857	192.168.7.25	192.168.7.20	20573	4433 UDP	20573 + 4433 Len=22			416 192.168.7.25	192.168.7.35	93	4433 UDP	93 + 4433 Lenz22	
858	192.168.7.25	192.168.7.30	19539	4433 UDP	19539 - 4433 Len=22			417 192.168.7.25	192.168.7.35	28302	4433 LDP	28302 - 4433 Len=22	
859	192.168.7.25	192.168.7.35	53853	4433 UDP	53853 + 4433 Len=22			418 192.168.7.25	192.168.7.35	1173	4433 UDP	1173 - 4433 Len=22	
860	192.168.7.25	192.168.7.20	33362	4433 UDP	33362 + 4433 Len=22			419 192.168.7.25	192.168.7.35	5290	4433 UDP	5290 + 4433 Len+22	
861	192.168.7.25	192.168.7.30	48247	4433 UDP	48247 + 4433 Len+22			420 192.168.7.25	192.168.7.35	60037	4433 LOP	68037 = 4433 Len+22	
862	192.168.7.25	192.168.7.35	47833	4433 UDP	47033 + 4433 Len+22			421 192.168.7.25	192.168.7.35	18737	4433 UDP	10737 → 4433 Len+22	
863	192.168.7.25	192.168.7.20	51755	4433 UOP	51755 + 4433 Len+22			422 192.168.7.25	192.168.7.35	44033	4433 UDP	44033 - 4433 Len=22	
864	192.168.7.25	192.168.7.30	9412	4433 UDP	9412 + 4433 Len+22			423 192.168.7.25	192.168.7.35	65135	4433 UDP	65135 = 4433 Len=22	
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866	192.168.7.25	192.168.7.20	17518	4433 UDP	17518 + 4433 Len=22			425 192.168.7.25	192.168.7.35	47033	4433 UDP	47033 - 4435 Len=22	
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Figure 26 Wireshark capture of UDP packet transmission

8 Demonstration of UDP Packet Filtering

In this demonstration showcase how to implement UDP packet filtering within the system. The focus will be on configuring the access list to control the flow of UDP packets based on their destination IP address. It will show how certain packets can be selectively blocked from reaching specific servers, while allowing others to be routed to their designated destinations.

8.1 Add Access List Entry and Switch to Destination Mode

First, configure access list to control the routing of UDP packets to specific servers. Set up rules to ensure that UDP packets destined for 192.168.7.30 on port 4433 are not forwarded to any port, effectively filtering out these packets from being sent to any interface card. On the other hand, packets intended for 192.168.7.20, 192.168.7.25, and 192.168.7.35 on port 4433 will be directed to the designated interfaces as specified in our access list configuration. Then switch the system to destination mode, allowing the packet routing to be based on the destination IP addresses.





8.2 View all Entries in Access List

After defining the lists, verify the configuration using the showlist command.

>>	sho	owlist			
Ν	um	Action	Protocol	IP Address	Port
	1	0000	UDP	192.168.7.30	4433
	2	0100	UDP	192.168.7.35	4433
	3	0010	UDP	192.168.7.20	4433
	4	0001	UDP	192.168.7.25	4433



8.3 Open UDP Server to Listen on Port 4433

To receive the UDP packets, the server needs to run by excusing "server.py" with ip address and port of ethernet interface.

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D:\Softw Listenin	ware>py ng for	/ Server.py 192.168.7.25:4433 incoming data on port 4433. Press Ctrl+C to stop.		D:\Softwar Listening	e>py for	/ Server.py 192.168.7.35:4433 incoming data on port 4433. Press Ctrl+C to stop.	
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D:\Softw Listenin	ware>py ng for	/ Server.py 192.168.7.20:4433 incoming data on port 4433. Press Ctrl+C to stop.		D:\Softwar Listening	e>py for	Server.py 192.168.7.30:4433 incoming data on port 4433. Press Ctrl+C to stop.	

Figure 29 Example of opening UDP servers listening on port 4433 for all four channels



8.4 Packet Transmission

Configure the UDP client to send packets to the following servers. Open the "Client.py" script and update the "server" variable as shown below.



Figure 30 Example of updating the "server" variable in UDP client

Run the UDP client with the following command to start sending packets through the interface with IP 192.168.7.25.

D:\Software>py Client.py 192.168.7.25	
Success : send 100 packet with delay 0 Second.	

Figure 31 Example of command to start UDP client

8.5 Result

From the demonstration, it can be observed that the UDP client sends data to UDP servers at 192.168.7.30, 192.168.7.35, and 192.168.7.20. Each UDP server successfully receives and displays the data, except for the server at 192.168.7.30, which does not receive any packets. Figure 33 shows the Wireshark capture, where the interface 192.168.7.25 is seen sending data to 192.168.7.20, 192.168.7.30, and 192.168.7.35. The other interface card only receives packets that match its own IP address, except for interface 192.168.7.30 having no packets received. This indicates that the system filtered out packets intended for IP 192.168.7.30.

⊠ py X			🖾 py			<u>A</u>
D:\Software>py Server.py 192 Listening for incoming data	2.168.7.25:4433 on port 4433. Press Ctrl+C to stop.		recv from i recv from i	p=192.168.7.25:27207 p=192.168.7.25:39199 p=192.168.7.25:34677 p=192.168.7.25:48931 p=192.168.7.25:48931 p=192.168.7.25:44931 p=192.168.7.25:40910 p=192.168.7.25:40910 p=192.168.7.25:57334 p=192.168.7.25:61731 p=192.168.7.25:10986 p=192.168.7.25:10986 p=192.168.7.25:10986 p=192.168.7.25:10986 p=192.168.7.25:12388 p=192.168.7.25:13239 p=192.168.7.25:13239 p=192.168.7.25:13239 p=192.168.7.25:13239 p=192.168.7.25:13239 p=192.168.7.25:13239 p=192.168.7.25:131094 p=192.168.7.25:31094 p=192.168.7.25:31094	data='msg 79 to 192.1 data='msg 80 to 192.1 data='msg 81 to 192.1 data='msg 81 to 192.1 data='msg 82 to 192.1 data='msg 83 to 192.1 data='msg 85 to 192.1 data='msg 85 to 192.1 data='msg 88 to 192.1 data='msg 90 to 192.1 data='msg 91 to 192.1 data='msg 91 to 192.1 data='msg 95 to 192.1	58.7.35' 57.5' 5
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recv from ip=192.168.7.25:52 recv from ip=192.168.7.25:46 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:44 recv from ip=192.168.7.25:44 recv from ip=192.168.7.25:42 recv from ip=192.168.7.25:22 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:33 recv from ip=192.168.7.25:35 recv from ip=192.168.7.25:32 recv from ip=192.168.7.25:32 recv from ip=192.168.7.25:32	2951 data='msg 79 to 192.168.7.20' 3562 data='msg 80 to 192.168.7.20' 3564 data='msg 81 to 192.168.7.20' 36495 data='msg 81 to 192.168.7.20' 3636 data='msg 82 to 192.168.7.20' 3663 data='msg 83 to 192.168.7.20' 3652 data='msg 84 to 192.168.7.20' 5573 data='msg 85 to 192.168.7.20' 5512 data='msg 87 to 192.168.7.20' 352 data='msg 87 to 192.168.7.20' 491 data='msg 89 to 192.168.7.20' 4522 data='msg 99 to 192.168.7.20' 352 data='msg 91 to 192.168.7.20' 3517 data='msg 93 to 192.168.7.20' 3619 data='msg 95 to 192.168.7.20' 364 data='msg 95 to 192.168.7.20' 364 data='msg 98 to 192.168.7.20' 364 data='msg 98 to 192.168.7.20' 365 data='msg 95 to 192.168.7.20' 364 data='msg 98 to 192.168.7.20' 4852 data='msg 98 to 192.168.7.20' 4852 <td></td> <td>D:\Software Listening f</td> <td>>py Server.py 192.160</td> <td>3.7.30:4433 port 4433. Press Ctrl+4</td> <td>to stop.</td>		D:\Software Listening f	>py Server.py 192.160	3.7.30:4433 port 4433. Press Ctrl+4	to stop.

Figure 32 Example of UDP servers receiving data from UDP client



UDP Packet Switching

Capturing from Ethernet 5					40	pluting from Etherset fi					
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No. Source	Destination	Src port Des port	votocol Information		No.	Source	Destination	Src port 1	Nes port Protoc	ol Information	
919 192.168.7.25	192.168.7.30	52144 4433 U	OP 52144 + 4433 Len=22			623 192.168.7.25	192.168.7.35	11387	4433 UDP	11387 + 4433 Len+22	
920 192.168.7.25	192.168.7.35	19986 4433 0	DP 10966 + 4433 Len=22			624 192.168.7.25	192.168.7.35	10029	4433 UDP	18029 + 4433 Len=22	
921 192.100.7.25	192.100.7.20	53725 4453 0	0P 53725 9 9933 Len+22			625 192.106.7.25	192.200.7.33	10000	4433 100	10000 - 4433 Len+22	
923 192 168 7 25	192.168.7.35	8040 4433 0	DP 8868 + 4413 Len+22			627 192 168 7 25	192.168.7.35	16429	4433 LDP	16420 - 4433 Lenv22	
924 192,168,7,25	192,168,7,20	15617 4433 U	DP 15617 + 4433 Lens22			628 192, 168, 7, 25	192, 168, 7, 35	59378	4433 LIDP	50378 + 4433 Lenu22	
925 192.168.7.25	192.168.7.30	54359 4433 U	OP 54359 + 4433 Len=22			629 192.168.7.25	192.168.7.35	44729	4433 UDP	44729 + 4433 Lenz22	
926 192.168.7.25	192.168.7.35	12388 4433 U	OP 12388 + 4433 Len=22			630 192,168.7.25	192.168.7.35	594	4433 UDP	594 - 4433 Lenin22	
927 192.168.7.25	192.168.7.20	39819 4433 U	OP 39819 → 4433 Len=22			631 192.168.7.25	192.168.7.35	27287	4433 LIDP	27207 + 4433 Len=22	
928 192.168.7.25	192.168.7.30	54825 4433 U	OP 54825 + 4433 Len+22			632 192.168.7.25	192.168.7.35	19199	4433 UDP	19199 + 4433 Len+22	
929 192.168.7.25	192.168.7.35	35285 4433 U	DP 35285 + 4433 Len+22			633 192,168.7.25	192.168.7.35	\$4677	4433 UDP	54677 - 4433 Lenv22	
930 192.168.7.25	192.168.7.20	9799 4433 U	OP 9799 + 4433 Len=22			634 192.168.7.25	192.168.7.35	8329	4433 UDP	8329 - 4433 Len=22	
931 192.168.7.25	192.168.7.90	18652 4433 U	OP 10652 + 4433 Len+22			635 192.168.7.25	192.168.7.35	48931	4433 UDP	48931 + 4433 Len+22	
932 192.168.7.25	192.168.7.35	28577 4433 0	OP 28577 + 4433 Len+22			656 192.168.7.25	192.168.7.35	41741	4433 UDP	41741 + 4433 Len+22	
953 192.168.7.25	192.168.7.26	22636 4433 0	UP 22535 + 4433 Len+22			657 192.168.7.25	192.168.7.35	28814	4433 UDP	20010 - 4433 L09+22	
015 107 168 7 75	192.168.7.35	11230 4433 1	OP 11239 + 4433 (apr-22			650 102 168 T 15	102 168 7 35	\$7134	4433 100	57114 - 4413 (any 72	
916 103 168 7 35	192 165 7 20	16749 4611 1	DP 16269 + 4413 (ans/22			640 107 168 7 25	102 168 7 15	61733	4433 100	61711 + 4413 Lenv22	
937 192, 168, 7, 25	192.168.7.30	41734 4433 U	OP 41734 + 4433 Len+22			641 192.168.7.25	192,168,7,35	6076	4433 UDP	6076 - 4433 Len+22	
938 192.168.7.25	192.168.7.35	2134 4433 U	DP 2134 → 4433 Len=22			642 192.168.7.25	192.168.7.35	10985	4433 UDP	10986 + 4433 Len=22	
939 192.168.7.25	192.168.7.20	53640 4433 U	DP 53648 + 4433 Len=22			643 192.168.7.25	192.168.7.35	8040	4433 UDP	8040 - 4433 Lens22	
940 192.168.7.25	192.168.7.30	1081 4433 U	OP 1081 + 4433 Len=22			644 192.168.7.25	192.168.7.35	12388	4433 UDP	12388 - 4433 Len=22	
941 192.168.7.25	192.168.7.35	14298 4433 U	OP 14298 + 4433 Len=22			645 192.168.7.25	192.168.7.35	35285	4433 UDP	35285 - 4433 Len=22	
942 192.168.7.25	192.168.7.20	24852 4433 U	DP 24852 + 4433 Len=22			646 192.168.7.25	192.168.7.35	28577	4433 UDP	28577 + 4433 Len=22	
943 192.168.7.25	192.168.7.30	41463 4433 U	DP 41463 - 4433 Len=22			647 192.168.7.25	192.168.7.35	13239	4433 UDP	13239 + 4433 Len=22	
944 192.168.7.25	192.168.7.35	31094 4433 U	DP 31094 + 4433 Len=22			648 192.168.7.25	192.168.7.35	2134	4433 UDP	2134 - 4433 Len=22	
945 192.168.7.25	192.168.7.20	21098 4433 0	OP 21098 + 4433 Len+22			649 192.168.7.25	192.168.7.35	14298	4433 UDP	14298 + 4433 Lenv22	
946 192.100.7.25	192.100.7.50	14919 4433 0	OP 14010 + 4400 L00022			650 152.108.7.25	192.100.7.35	51094	4433 UDP	31094 # 4433 Leng23	
747 172,100,7,25	172.100.7.25	37000 ++33 0	0P 57666 4 4433 L01422		×	051 151.100.7.23	191.100.7.33	37660	4433 UUP	3/800 * 4433 LEINZA	
Thernet 5: Ethernet 5: 			Packets: 994 - Displayed: 9	0 (30.2%) Profile: Default	0	Ethernet 6: live capture in progres	55>			Packets: 685 - Displayed: 100 (14.6%)	Profile: Default
Capturing from Ethemet 10					40	pturing from Ethernet 11					- D X
The Late Many Co. Continue Analysis (1)					124	Edit Mars Ga Cambras Analys	- Statistics Talachomy Missians To	als Made			
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605 192.168.7.25	192.168.7.20	56345 4433 U	DP 56345 + 4433 Len+22								
686 192.168.7.25	192.168.7.20	48124 4433 U	OP 40124 + 4433 Len=22								
607 192.168.7.25	192.168.7.20	1180 4433 U	DP 1188 + 4433 Len=22								
608 192.168.7.25	192.168.7.20	9268 4433 U	OP 9268 + 4433 Len+22								
689 192.168.7.25	192.168.7.20	48609 4433 U	OP 48689 → 4433 Len+22								
610 192.168.7.25	192.168.7.20	63158 4433 0	OP 63158 + 4433 Len+22								
611 192,168.7.25	192.168.7.20	9308 4433 0	OP 9308 + 4433 Len+22								
612 192.100.7.25	192.100.7.20	13051 A411 U	0P 20221 + 4433 Len-13								
614 192, 168, 7, 25	192.168.7.20	48562 4433 U	OP 48562 + 4433 Lenu22								
615 192.168.7.25	192.168.7.20	36485 4433 1	OP 36485 + 4433 Len=22								
616 192.168.7.25	192.168.7.20	36063 4433 U	DP 36063 + 4433 Len=22								
617 192.168.7.25	192.168.7.20	24336 4433 U	DP 24336 + 4433 Len=22								
618 192.168.7.25	192.168.7.20	16573 4433 U	OP 16573 + 4433 Len=22								
619 192.168.7.25	192.168.7.20	46652 4433 U	OP 46652 + 4433 Len=22								
620 192.168.7.25	192.168.7.20	45128 4433 U	DP 45128 → 4433 Len=22								
621 192.168.7.25	192.168.7.20	17941 4433 U	DP 17941 + 4433 Len=22								
622 192.168.7.25	192.168.7.20	24532 4433 U	OP 24532 + 4433 Len=22								
623 192.168.7.25	192.168.7.28	491 4433 0	UP 491 + 4455 L40#22								
624 192.188.7.25	192.168.7.20	24522 4433 U	DP 22775 + 4433 L00+22								
626 192, 168, 7, 25	192.168.7.20	15617 4415 1	DP 15617 + 4411 Len#22								
627 192,168,7,25	192.168.7.20	39819 4433 U	OP 39819 + 4433 Len+22								
628 192,168,7,25	192.168.7.20	9799 4433 U	OP 9799 → 4433 Len+22								
629 192.168.7.25	192.168.7.20	22636 4433 U	OP 22636 + 4433 Len=22								
630 192.168.7.25	192.168.7.20	36249 4433 U	OP 36249 + 4433 Len+22								
631 192.168.7.25	192.168.7.20	53640 4433 U	OP 53648 + 4433 Len=22								
632 192.168.7.25	192.168.7.20	24852 4433 U	DP 24852 + 4433 Len=22								
633 192.168.7.25	192.168.7.20	21098 4433 U	OP 21098 + 4433 Len=22		~						
4				>	e						5
C Z Ethernet 10 class centure in programs			Packets: 669 - Displayed: 1	0 (14.9%) Profile: Default	.03	Ethernet 11: clive capture in progr	6852			Packets: 426 - Displayed: 0 (0.0%)	Profile: Default

Figure 33 Wireshark capture of UDP packet transmission



Revision History 9

Revision	Date (D-M-Y)	Description				
1.01	14-Oct-24	Update table of contents.				
1.00	2-Oct-24	Initial version release				