

tCAM IP Search Replace Demo Instruction

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tCAM IP Search Replace Demo Instruction

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This document describes the instruction to demonstrate the operation of tCAMIP on Kintex UltraScale+ (KCU116) development board. This demonstration shows search/replace text function by using tCAMIP on KCU116 board via 10 Gigabit Ethernet communication.

1 Environment Setup

To operate tCAMIP demo, please prepare following test environment.

- 1) FPGA development boards (KCU116 development board)
- 2) Test PC with 10 Gigabit Ethernet card.
- 3) Micro USB cable for JTAG connection between FPGA development board and Test PC
- 4) 10Gb Ethernet cable (SFP+ to SFP+).
- 5) Vivado Hardware Manager for programming FPGA, installed on Test PC
- 6) File "tCAMIPSearchReplacePack-KCU116.zip" that included Test Application named "tCAMIP Search Replace" and configuration file named "tCAMIPRef+.bit".

(To download this file, please visit our web site at www.design-gateway.com)



Figure 1-1 tCAMIP reference design 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

📮 Local Area Connection 2 Properties 📃 💌	Internet Protocol Version 4 (TCP/IPv4) Properties
Networking Sharing	General
Connect using: 10-Gb LAN connection	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 Obtain an IP address automatically
This connection uses the following items:	Use the following IP address:
Client for Microsoft Networks	IP address: 192 . 168 . 7 . 81
Packet Driver (NPCAP) (wiPi) Packet Driver (NPCAP)	Subnet mask: 255 . 255 . 255 . 0
QoS Packet Scheduler File and Printer Sharing for Microsoft Networks	Default gateway:
Internet Protocol Version 6 (TCP/IPv6)	Obtain DNS server address automatically
< III +	Use the following DNS server addresses:
Install	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.	Vaļidate settings upon exit Advanced
OK Cancel	OK Cancel



- 1) Open Local Area Connection Properties of 10-Gb connection, as shown in the left window of Figure 2-1.
- 2) Select "TCP/IPv4" and then click Properties.
- 3) Set IP address = 192.168.7.81 and Subnet mask = 255.255.255.0, as shown in the right window of Figure 2-1.



2.2 Speed and Frame Setting

🎚 Local Area Connection 2 Properties 📃 💌	Local Area Connection 2 83
Networking Sharing Connect using:	You have made changes to the properties of this connection. If you proceed your changes will be lost. Do you wish to proceed? <u>Y</u> es <u>No</u>
Npcap Packet Driver (NPCAP) QoS Packet Scheduler File and Printer Sharing for Microsoft Networks File and Printer Sharing for Microsoft Networks Internet Protocol Version 6 (TCP/IPv6) Internet Protocol Version 4 (TCP/IPv4) Internet Protocol Version 4 (TCP/IPv4) Install Uninstall Properties Description Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication perces diverse intercompacted metworks	Intel(R) Ethernet Server Adapter X526 VLANs Boot Options Driver Details General Link Speed Advanced Teaming Image: Colspan="2">Advanced Adapter Settings
OK Cancel	Settings: Interrupt Moderation Large Send Offload V2 (IPv4) Large Send Offload V2 (IPv6) Locally Administered Address Log Link State Event Offloading Options Performance Options
	Jumbo Packet Enables Jumbo Packet capability for TCP/IP packets. In situations where large packets make up the majority of traffic and additional latency can be tolerated, Jumbo Packets can reduce CPU utilization and improve wire efficiency. WOTE: Changing this setting may cause a momentary loss of connectivity. Usage Considerations
	OK Cancel



- 1) On Local Area Connection Properties window, click "Configure" as shown in Figure 2-2.
- 2) On Advanced Tab, select "Jumbo Packet". Set Value to "9014 Bytes" for Jumbo Frame support or set value to "Disabled" for non-Jumbo Frame support, as shown in the bottom window of Figure 2-2.



3) On Link Speed, select "10 Gbps Full Duplex" for running 10-Gigabit transfer test, as shown in Figure 2-3.

ntel(R) Ethernet	Server Adapte	r X520-2 Pro	perties		×
Teaming General	VLANs Advanced	Boot Option Link Spe	is ied	Driver PROSet	Details Advanced
Link Status Speed:	Link Speed an Intel(R) PROS 10.00 G	nd Duplex Set iet Version: 25 ibps Full Duple	ttings 5.0.0.10 ex	00	
Speed and Du 10 Gbps Full D	olex: Tuplex	3		<u>D</u> iagnostics.	
		[ld	entify <u>A</u> dapt	er
Speed and to automatic: A setting oth advertises d	Duplex Settin ally detect and r er than Auto Ne uring auto-nego nation icon	g: By default, negotiate sper egotiation rest otiation.	Intel® a ed and c tricts w f	idapters are duplex settin nat the adap	eset Igs. Iter
This icon is o maximum cap	lisplayed when pable speed. In	the device is that case, if y	not link our dev	ed at its vice is set to	
				ОК	Cancel

Figure 2-3 Set link speed = 10 Gbps



- 4) On PROSet Advanced Tab, select "Performance Options" and click "Properties" button.
- 5) Set "Interrupt Moderation Rate" = OFF.

Intel(R) Ethernet Server Adapter X520-2 Properties	Performance Options
Settings: Log Link State Event Offloading Options Priority & VLAN Receive Side Scaling Receive Side Scaling Queues Performance Options Configures the adapter to use settings that can improve adapter	Use Derault Interrupt Moderation Rate This sets the rate at which the controller moderates or delays the generation of interrupts making it possible to optimize netw ork throughput and CPU utilization. The Adaptive setting adjusts the interrupt rates dynamic ally depending on traffic type and netw ork usage. Choosing a different setting may improve netw ork and system performance in certain configurations. Without interrupt moderation, CPU utilization increases at higher QK Cancel
performance.	

Figure 2-4 Interrupt Moderation Rate

- 6) Select "Low Latency Interrupts" and click "Properties" button.
- 7) On "Low Latency Interrupts" window, select "Use Low Latency Interrupts" and click "OK" button.
- 8) Click "OK" button to save and exit all setting windows.

Performance Options	Low Latency Interrupts
Settings: Direct Cache Access Properties Flow Control 6 Interrupt Moderation Rate 6 Inverse Buthers 6 Transmit Buffers 6 Low Latency Interrupts 6 Enables adapters to bypass interrupt moderation and immediately generate an interrupt when certain TCP packets arrive, allowing the system to handle the packet more quickly. Certain applications will have faster access to network data because of the reduced data latency. Image: NOTES: • If this option is enabled system CPI I utilization •	Image: Section Latency Interrupts Add New Port: Add Image: Section Latency Interrupts Add Remove Image: Section Latency Interrupt moderation and trigger immediate interrupts. Use for packets with TCP Any incoming packet with the TCP PSH flag will trigger an immediate interrupt. The PSH flag is set by the sending device. Use for these TCP ports: Every packet received on the Immediate interrupt. The PSH flag is set by the sending device.

Figure 2-5 Use Low Latency Interrupts



2.3 Power Option Setting

- 1) Open Control Panel and select Power Options as shown in the left window of Figure 2-6.
- 2) Change setting to High Performance as shown in the right window of Figure 2-6.



Figure 2-6 Power options



3 FPGA board setup

- 1) Make sure power switch is off and connect power supply to KCU116 development board.
- 2) Connect 10Gb SFP+ cable from KCU116 board to PC.
- 3) Connect USB cable between PC to JTAG micro USB port.



Figure 3-1 Power, Ethernet, and micro-USB cable connection for KCU116 board

- 4) Power on system.
- 5) Open Vivado Hardware Manager to program FPGA by following step.
 - a) Click "Auto Connect" to connect with board.
 - b) Right click at "xcku5p_0", then select "Program device ..."
 - c) Select ".bit" for configuration bit file.
 - d) Select ".ltx" for debug probe file.
 - e) Press "Program" button to program device.

🕕 Vivado 2019.1					- 0	×
Eile Edit Iools Reports Window Lay	yout View Help Q. Quick Access					
	🔀 Dashboard 👻				📰 Default Layout	~
HARDWARE MANAGE	210308AB9D59					? >
(a)						
Hardware ? _ O & X	MIG - MIG_1					I 🗆 🗙
Q 素 ≑ Ø ▶ ≫ ■ ◆	C					
Name Status	Recorder	Collinguities and Manufacture				
✓ I localhost (1) Connected	Properties	Calibration and Margins				
✓ ■ ✓ xilinx_tcf/Digilent/2 Open	Name: MIG_1	Table Chart (Rank 0) -	Left Aligned Chart (Rank 0) - Ce	enter Aligned		
✓	Hardware Device Properties Ctrl+E	Q, ¥ ≑ Ps	Read Mode 👻 Simple Pattern	✓ Rising Clock E	idge 💙	
1 SysMon (Syste	Program Device	Name	Left Margin (ps) Cente	er Point (ps)	Right Margin (ps)	
	Verify Device	V Rank 0				
c	Refresh Device	✓ Byte 0				
	Show Bus Plot	Nibble 0	184	235		184
	Add Configuration Mamons Device	Nibble 1	180	213		184
Hardware Device Properties ? _ D	Root from Configuration Memory Device	Nibble 0	191	230		195
@ xcku5p_0 ← →		Nibble 1	188	206		191
Name: xcku5p_0	Clear PPP Key	✓ Byte 2				
Part: xcku5p		Nibble 0	191	239		191
ID code: 044652002	Program eFUSE Registers	Nibble 1	180	249		180
10 code: 04A62095	Export to Spreadsheet	✓ Byte 3				
IR length: 6	6 - Read DOS Centering (Simple) PASS	Nibble 0	191	245		195
Status: Programmed	7 - Read Sanity Check PASS	Nibble 1	184	232		188
General Properties	8 - Write DQS to DQ Deskew PASS 🗸					
deneral rioperaes						
Tcl Console × Messages Serial I/O Links	Serial I/O Scans				? _	
Q						
☐ INFO: [Labtools 27-1964] The ILA corr	e 'hw ila 1' trigger was armed at 2021-J	un-10 15:00:22				^
wait_on_hw_ila [get_hw_ilas -of_obje	cts [get_hw_devices xcku5p_0] -filter [C	ELL_NAME=~"u_ila_0"}]				
<pre>Use display_hw_ila_data [upload_hw_ila_d] UNFO: [Labtools 27-1966] The ILA cor</pre>	ata [get_hw_ilas -of_objects [get_hw_dev e 'hw ila 1' triggered at 2021-Jun-10 15	<pre>ices xcku5p_0] -filte: :00:27</pre>	r {CELL_NAME=~"u_ila_0"}]]			
INFO: [Labtools 27-3304] ILA Wavefor	m data saved to file C:/Users/pahol/AppD	ata/Roaming/Xilinx/Vi	vado/.Xil/Vivado-33796-Jack	PC/backup/hw_il	a_data_1.ila. Use) TC
C ERROR: [Labtoolstcl 44-513] HW Targe	t shutdown. Closing target: localhost:31	21/xilinx_tcf/Digilen	t/210308AB9D59			
<						>
Type a Tcl command here						
Hardware Device: xcku5p_0						

Figure 3-2 Vivado Hardware Manager



4	Program Device		×
Se ha fil	elect a bitstream prog ardware device. You c e that corresponds tc tstream programmin	ramming file and download it to your an optionally select a debug probes o the debug cores contained in the g file.	C
	Bitstre <u>a</u> m file:	/ado/vivado.runs/tCAMIPTest+.bit	
	Debug probes file:	vivado/vivado.runs/tCAMIPTest.ltx 🛇	
	✓ Enable end of st	artup check	D d
(?	e Program Ca	ncel

Figure 3-3 Program Device

- 6) When configuration is completed, user can check status LEDs on board as Figure 3-4.
 - LED0 is always blink to show clock is working.
 - LED1 is turned on when TOE10GIP is ready for data transfer.
 - LED2 is turned on when tCAMIP is initialized successfully.
 - LED3 is turned on when software open connection to S10MX board.



Figure 3-4 LED[3:0] status on board



4 tCAMIP Search Replace demo software

tCAMIP Search Replace demo software is designed to do search/replace text function by using space bar to be delimiter. tCAMIP Replace button is search and replace text by using tCAMIP on KCU116 board via 10 Gigabit Ethernet.

4.1 Demo software interface description

🖳 tCAN	MIP Search Replace				×
tCAMIP S	Search Replace d				
Conne	Software Replace 3586				
Disconr	nect tCAMIP Replace				
۲ م)	— (e)				
Search	Replace	Search	Replace		^
White	word001	word001	word001		
nurse	word003	word002	word003		
worse	word004	word004	word004		
horse	word0	word005	word005		
Horse	word a	word006	word005		
noise	word008	word008	word00 D		
three	word009	word009	word009		
city	word010	word010	word010		
duty	word011	word011	word011		
Duty	word012	word012	word012		
busy	word014	word014	word014		
easy	word015	word015	word015		
Busy	word016	word016	word016		
bury	word017	word017	word017		
very	word019	word019	word018		
Bury	word020	word020	word020		
many	word021	word021	word021		
tiny	word022	word022	word022		
Deny	word023	word023	word023		
Many	word025	word024	word025		
lady	word026	word026	word026		~
1 1	7001	1007	2007		10.00

Figure 4-1 Software interface

Figure 4-1 shows tCAMIP Search Replace user interface and the description is shown as below.

- a) Input source text for search. ("input.txt" is sample text)
- b) Output result text after replace.
- c) Connect/Disconnect with KCU116 board via 10 Gigabit Ethernet.
- d) Software Replace, this button will search and replace text with software.
- e) tCAMIP Replace, this button will be sent source text via 10 Gigabit Ethernet to search and replace text by using tCAMIP.

4.2 Search and Replace sample table

Please refer sample table of search and replace word in file "SampleTable.txt".

4.3 Sample text

"SampleText.txt" is prepared for sample of input source text. Figure 4-2 shows sample result using "SampleText.txt"



🛃 tCAMIP Search Replace tCAMIP Search Replace Connect Software Replace 177414 / 177414 Disconnect tCAMIP Replace ▲ [Sample Text] [Sample Text] There was once a young Shepherd Boy who tended his sheep at the foot of a mountain near a dark forest. It was rather lonely for him all day, so he thought upon a plan by which he could get a There was once a young Shepherd Boy who tended his sheep at the foot of a mountain near a word225 forest. It was rather lonely word579 word636 all day, word697 word705 thought upon a plan word703 which word705 could word538 a little company and word420 excitement. little company and some excitement. word712 rushed down towards the village calling word544 Wolf. Wolf. And the villagers word423 word544 word699 meet him, and word420 of them stopped word282 word636 word579 a consideration time. This pleased the boy word697 word305 word102 a word514 days afterwards He rushed down towards the village calling out Wolf, Wolf. And the Х him, and some of them stopped with him for a consideration time. The that a few days afterwards he tried the same trick, and again the vill word 705 tried the word 416 trick, and again the villagers word 423 word 699 his help textSize: 1042937 time: 1.303 seconds But shortly after this a wolf actually did came out from the forest and and the boy of course cried out wolf, wolf" still louder than before. word557 shortly after word133 a word315 actually did word423 word544 from the forest and began word699 wory the sheep, and the boy of course cried word544 wolf, wolf" still louder word157 before. But the villagers, who had fooled twice before, thought the boy was nobody stirred to come to his help. So the wolf made a good meal of OK word557 the villagers, who had fooled twice before, thought the boy was again deceiving them, and nobody stirred word699 word422 word699 his help. word715 the word315 made a good meal Moral of the story "Liars are not believed even when they speak the truth." off the boy's flock The Public Health Ministry's Department of Medical Sciences (DMS) on Monday assured the public of its Covid 19 testing capability as the country prepares for fresh infections now that most Moral of the story "Liars are word533 believed even when they speak the truth." businesses have reopened. The Public Health Ministry's Department of Medical Sciences (DMS) on Monday assured the public of its Covid 19 testing capability as the country prepares word579 fresh infections word509 word102 word030 businesses word327 reopened. The director general of the DMS, Opas Kankawinphong, on Monday outlined what the public health community was doing to prepare for a second wave of coronavirus infections even though the country has had no local cases for more than 50 days. The director general of the DMS, Opas Kankawinphong, on Monday outlined word107 the public Figure 4-2 Sample result using "SampleText.txt"

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5 Revision History

Revision	Date	Description
1.00	14-Jul-2021	Initial version release