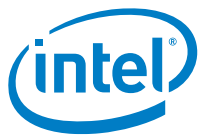# DPDK Intel NIC Performance Report Release 20.11
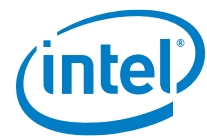
Test Date: Dec 24th, 2020

Author: Intel DPDK Validation team

Revision History

Date	Revision	Comment
Dec 24th, 2020	1.0	Initial document for release

Contents

Audience and Purpose

The primary audience for this test report is architects and engineers implementing the Data Plane Development Kit (DPDK). This report provides information on packet processing performance testing for the specified DPDK release on Intel® architecture. The initial report may be viewed as the baseline for future releases and provides system configuration and test cases based on DPDK examples.

The purpose of reporting these tests is not to imply a single "correct" approach, but rather to provide a baseline of well-tested configurations and procedures with reproducible results. This will help guide architects and engineers who are evaluating and implementing DPDK solutions on Intel® architecture and can assist in achieving optimal system performance.

Test Description

The device under test (DUT) consists of a system with an Intel® architecture motherboard populated with the following;
- A single or dual processor and PCH chip, except for System on Chip (SoC) cases
- DRAM memory size and frequency (normally single DIMM per channel)
- Specific Intel Network Interface Cards (NICs)
- BIOS settings noting those that updated from the basic settings
- DPDK build configuration settings, and commands used for tests

Connected to the DUT is an IXIA, a hardware test and simulation platform to generate packet traffic to the DUT ports and determine the throughput at the tester side. The IXIA is used to implement RFC2544 on the DUT.

Benchmarking a DPDK system requires knowledge of networking technologies including knowledge of network protocols and hands-on experience with relevant open-source software, such as Linux, and the DPDK. Engineers also need benchmarking and debugging skills, as well as a good understanding of the device-under-test (DUT) across compute and networking domains.

DPDK L3fwd Test Case: Documentation may be found at http://www.dpdk.org/doc/guides/sample_app_ug/l3_forward.html.

The application demonstrates the use of the hash and LPM libraries in the DPDK to implement packet forwarding. The lookup method is either hash-based or LPM-based and is selected at compile time. In this test case, the selected lookup method is the default LPM-based without modification, an LPM object is used to emulate the forwarding stage for IPv4 packets. The LPM object is used as the routing table to identify the next hop for each input packet at runtime.

The LPM lookup key is represented by the Destination IP Address field read from the input packet. The ID of the output interface for the input packet is the next hop returned by the LPM lookup. The set of LPM rules used by the application is statically configured and loaded into the LPM object at initialization time.

In the sample application, hash-based forwarding supports IPv4 and IPv6. LPM-based forwarding supports IPv4 only.

DPDK Testpmd Test Case: Documentation may be found at
http://www.dpdk.org/doc/guides/testpmd_app_ug/index.html.

The testpmd application can be used to test the DPDK in a packet forwarding mode and also to access NIC hardware features. Note in the Testpmd example if the –i argument is used, the first core is used for the command language interface (CLI).

Below is an example setup topology for the performance test. Generally, NIC ports in DUT connect to the traffic generator ports directly. And we will send bi-directional traffic from traffic generators and calculate the aggregated throughputs at the traffic generator side for the overall throughput. Please note the NIC port connections to traffic generator would vary from case to case.

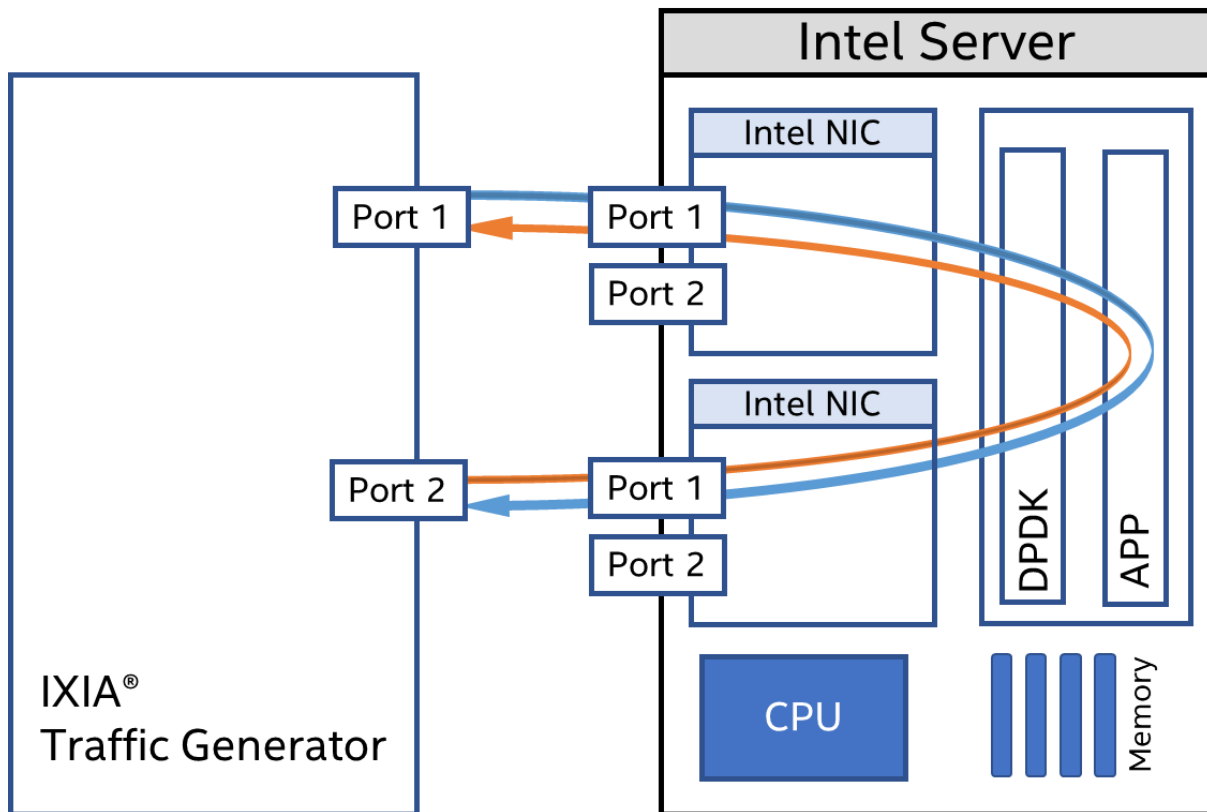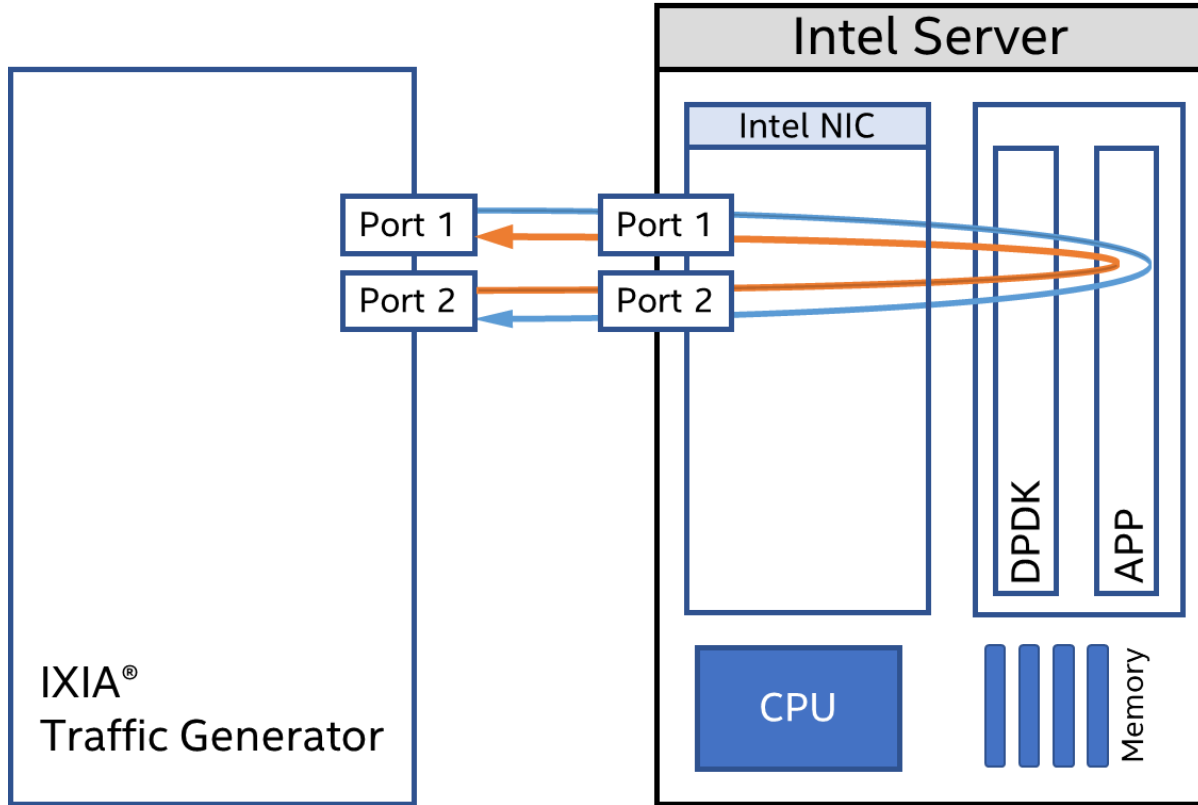**Figure 1: DPDK NIC performance test setup (1 port per NIC)**

Figure 2: DPDK NIC performance test setup (2 ports on 1NIC)

RFC2544 Zero packet loss test case: Used to determine the DUT throughput as defined in RFC1242(https://www.ietf.org/rfc/rfc1242.txt). Note RFC6201 https://www.ietf.org/rfc/rfc6201.txt has updated RFC2544 and RFC1242.Please check the link for more details. In this report, RFC2544 test uses DPDK l3fwd as test application.

Procedure: Send a specific number of frames at a specific rate through the DUT and then count the frames that are transmitted by the DUT. If the count of offered frames is not equal to the count of received frames, the rate of the offered stream is reduced and the test is rerun. The throughput is the fastest rate at which the count of test frames transmitted by the DUT is equal to the number of test frames sent to it by the test equipment.

Test settings: IxNetwork 8.40 is used here for the test execution. The duration for each round is 60 seconds, and the acceptable packet loss rate is 0. The traffic is 256 flows per port.

Single core test case: Used to check the maximum IO throughput for a single core. The case requires at least 4x 10GbE ports for the ixgbe DPDK Poll Mode Driver (PMD) and 2x 40GbE ports for the i40e DPDK PMD. In this case, we don't calculate the packet loss rate but record the average throughput within 60 seconds.

More details about the DPDK setup and BIOS information can be found at http://dpdk.org/doc/guides/linux_gsg/nic_perf_intel_platform.html

Test#1 RFC2544 zero packet loss test on 1x Intel® Ethernet Converged Network Adapter X710-DA4

Table 1: Test #1 Setup

Item	Description
Test Case	Test#1 RFC2544 zero packet loss test on 1x Intel® Ethernet Converged Network Adapter X710-DA4
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8180 CPU @ 2.50GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	1x Intel® Ethernet Converged Network Adapter X710-DA4
BIOS	SE5C620.86B.00.01.0013.030920180427
Microcode	0x2006906
Operating System	Ubuntu 18.04.4 LTS
Linux kernel version	5.3.0-62-generic
GCC version	gcc version 7.5.0 (Ubuntu 7.5.0-3ubuntu1~18.04)
Intel NIC Device ID	0x1572
Intel NIC Firmware version	8.00 0x80008b80 1.2766.0
DPDK version	20.11
Test configuration	1 NIC card attached to the first processor. 1 port assigned per logical core using 1 queue. Totaling 4 logical cores, 4 queues for 4ports

Figure 3: Test #1 Setup – 1x Intel® Ethernet Converged Network Adapter X710-DA4 connected to IXIA (4 ports on 1 NIC)
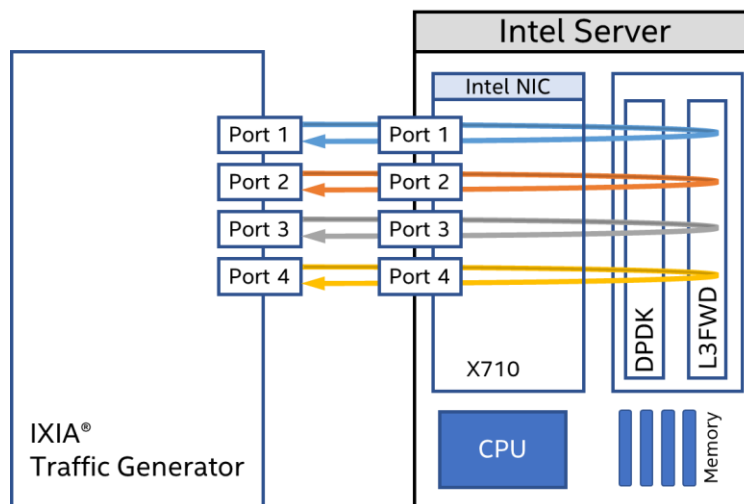
Table 2: Test #1 Setting

Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Turbo Boost Disabled
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21,28-48 nohz_full=1-21,28-48 rcu_nocbs=1-21,28-48
DPDK Settings	CC=gcc meson -Dlibdir=lib -Dexamples=l3fwd -Dc_args=-DRTE_LIBRTE_I40E_16BYTE_RX_DESC --default-library=static x86_64-native-linuxapp-gcc
Command line	dpdk-l3fwd -l 5-8 -n 6 -w 0000:18:00.0 -w 0000:18:00.1 -w 0000:18:00.2 -w 0000:18:00.3 -- -p 0xf --config '(0,0,5),(1,0,6),(2,0,7),(3,0,8)'

Test Results

Table 3: Test #1 Result

Frame Size (Bytes)	Line Rate[4x10G] (Mpps)	Frame Rate (Mpps)	% Line Rate
64	59.52	36.92	62.03
128	33.78	33.78	100
256	18.12	18.12	100
512	9.40	9.40	100
1024	4.79	4.79	100
1280	3.85	3.85	100
1518	3.25	3.25	100

Figure 4: Test #1 Result – RFC2544 zero packet loss test on 1x Intel® Ethernet Converged Network Adapter X710-DA4
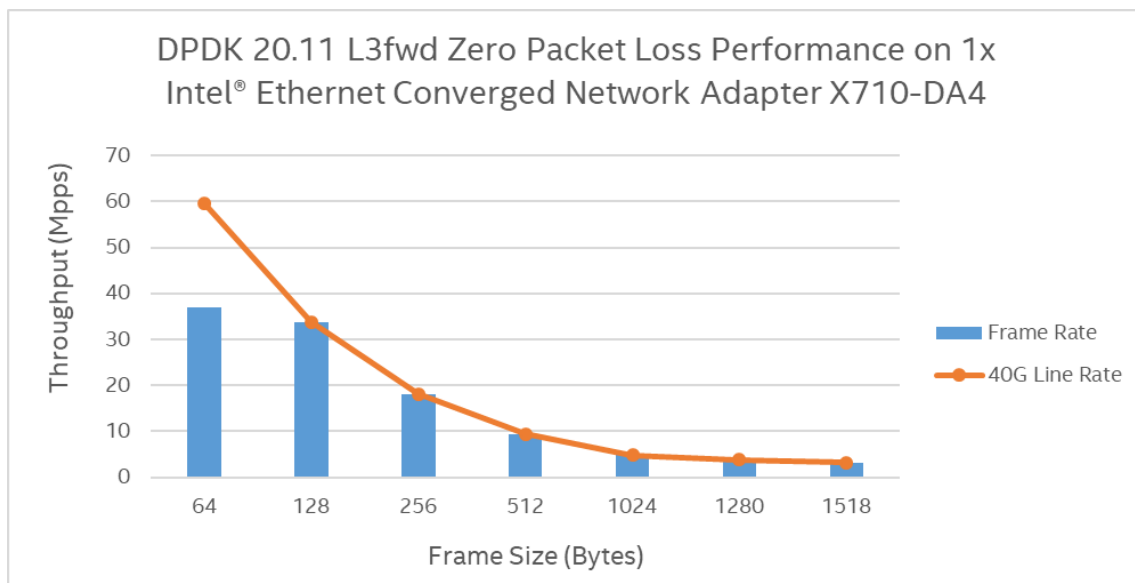
Test#2 RFC2544 zero packet loss test on 2x Intel® Ethernet Network Adapter XXV710-DA2

Table 4: Test #2 Setup

Item	Description
Test Case	Test#2 RFC2544 zero packet loss test on 2x Intel® Ethernet Network Adapter XXV710-DA2
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	2x Intel® Ethernet Network Adapter XXV710-DA2; PCIe 3.0 x8
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Operating System	Ubuntu 20.04 LTS
Linux kernel version	5.4.0-40-generic
GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x158b
Intel NIC Firmware version	8.00 0x80008c1a 1.2766.0
DPDK version	20.11
Test configuration	2 NIC cards attached to the first processor only 1st port used of each NIC. Each port has 2 queues assigned for a total of 4 queues 1 queue assigned per logical core. Totaling 4 logical cores, 4 queues for 2 ports

Figure 5: Test #2 Setup – 2x Intel® Ethernet Network Adapter XXV710-DA2 connected to IXIA (1 port per NIC)
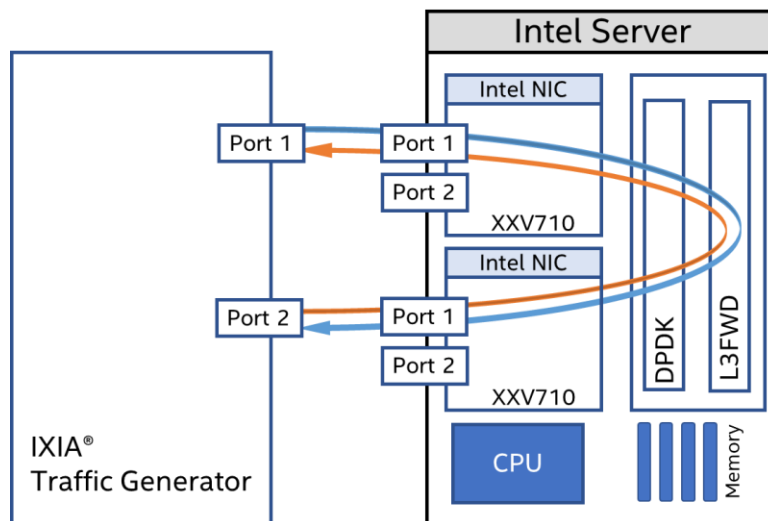
Table 5: Test #2 Setting

Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel(R) Hyper-Threading Tech Enabled Turbo Boost Disabled
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21,57-75 nohz_full=1-21,57-75 rcu_nocbs=1-21,57-75

DPDK Settings	Edited l3fwd/l3fwd.h
	    #define RTE_TEST_RX_DESC_DEFAULT 2048
	    #define RTE_TEST_TX_DESC_DEFAULT 2048

Command line	dpdk-l3fwd -l 6,7,62,63 -n 6 –w 18:00.0 –w 1a:00.0 -- -p 0x3 --config '(0,0,6),(0,1,7),(1,0,62),(1,1,63)'

Test Results

Table 6: Test #2 Result

Frame Size (Bytes)	Line Rate[2x25G] (Mpps)	Frame Rate (Mpps)	% Line Rate
64	74.40	74.40	100
128	42.23	42.23	100
256	22.65	22.65	100
512	11.75	11.75	100
1024	5.99	5.99	100
1280	4.81	4.81	100
1518	4.06	4.06	100

Figure 6: RFC2544 zero packet Loss test for 2x Intel® Ethernet Network Adapter XXV710-DA2
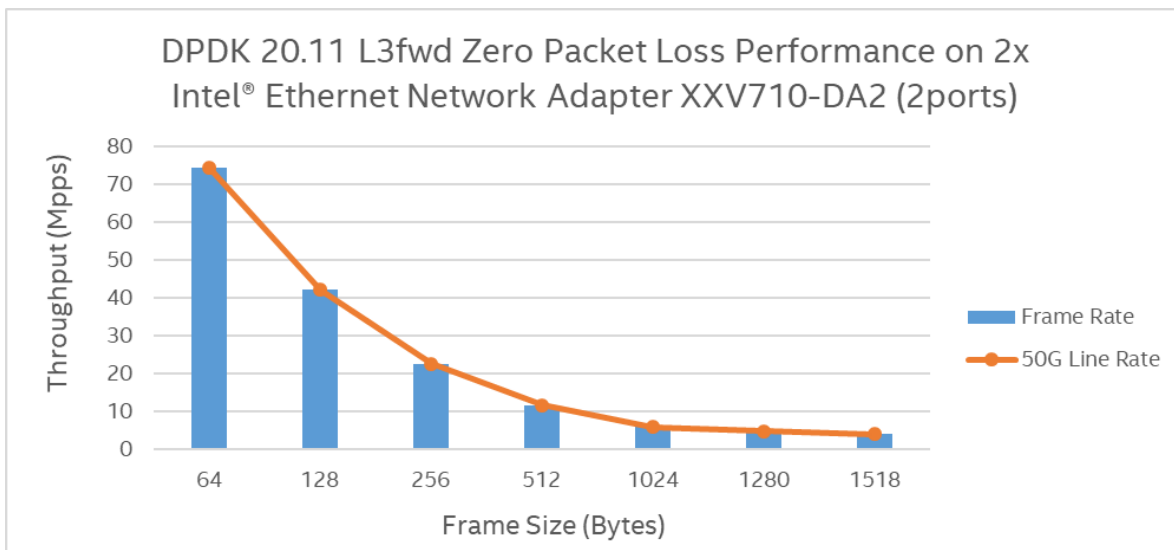
Test#3 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter XXV710-DA2

Table 7: Test #3 setup

Item	Description
Test Case	Test#3 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter XXV710-DA2
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	1x Intel® Ethernet Network Adapter XXV710-DA2; PCIe 3.0 x8
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Operating System	Ubuntu 20.04 LTS
Linux kernel version	5.4.0-40-generic
GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x158b
Intel NIC Firmware version	8.00 0x80008c1a 1.2766.0
DPDK version	20.11
Test configuration	1 NIC cards attached to the first processor and 2 ports of the NIC are used. Each port has 1 queue assigned for a total of 2 queues 1 queue assigned per logical core. Totaling 2 logical cores, 2 queues for 2 ports

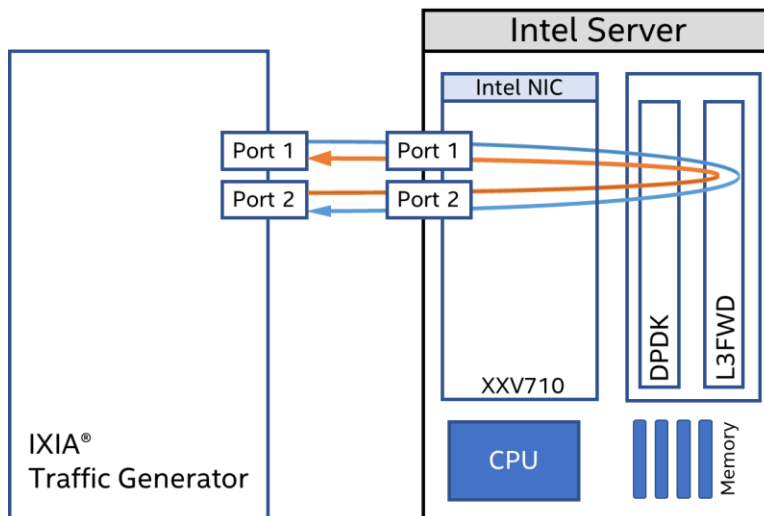**Figure 7: Test #3 Setup – 1x Intel® Ethernet Network Adapter XXV710-DA2 connected to IXIA (2 ports used on 1 NIC)**

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Table 8: Test #3 Setting

Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel(R) Hyper-Threading Tech Enabled Turbo Boost Disabled
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21,57-75 nohz_full=1-21,57-75 rcu_nocbs=1-21,57-75

DPDK Settings	Edited l3fwd/l3fwd.h
	    #define RTE_TEST_RX_DESC_DEFAULT 2048
	    #define RTE_TEST_TX_DESC_DEFAULT 2048
	CC=gcc meson -Dlibdir=lib -Dexamples=l3fwd -Dc_args=-DRTE_LIBRTE_I40E_16BYTE_RX_DESC --default-library=static x86_64-native-linuxapp-gcc

Command line	dpdk-l3fwd -l 6,62 -n 6 –w 18:00.0 –w 18:00.1 -- -p 0x3 --config '(0,0,6),(1,0,62)'

Test Results

Table 9: Test #3 Result

Frame Size (Bytes)	Line Rate[2x25G] (Mpps)	Frame Rate (Mpps)	% Line Rate
64	74.40	36.74	49.38
128	42.23	36.88	87.33
256	22.65	21.69	95.78
512	11.75	11.42	97.19
1024	5.99	5.82	97.21
1280	4.81	4.67	97.19
1518	4.06	3.92	96.50

Note: Due to hardware limitation, the throughput at large packets can only reach 95%-97% line rate.

Figure 8: RFC2544 zero packet Loss test for 1x Intel® Ethernet Network Adapter XXV710-DA2
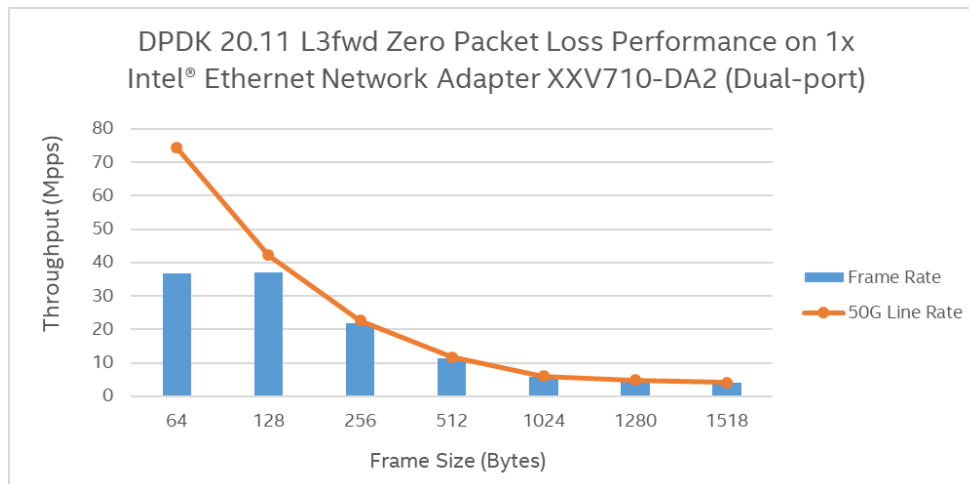
Test#4 i40e PMD Single core performance test

Table 10: Test #4 setup

Item	Description
Test Case	Test#4 i40e PMD Single core performance test
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	2x Intel® Ethernet Network Adapter XXV710-DA2; PCIe 3.0 x8
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Operating System	Ubuntu 20.04 LTS
Linux kernel version	5.4.0-40-generic
GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x158b
Intel NIC Firmware version	8.00 0x80008c1a 1.2766.0
DPDK version	20.11
Test configuration	2 NIC cards attached to the first processor only 1st port used of each NIC. Each port has 2 queues assigned for a total of 4 queues All queues are assigned to the same logical core. The first core defined is for the CLI of the Testpmd example due to the –i argument. I40E Vector PMD and IO forwarding is used for the test. Test duration is 60 seconds.

Figure 9: Test #4 Setup – 2x Intel® Ethernet Network Adapter XXV710–DA2 connected to IXIA (1 port per NIC)
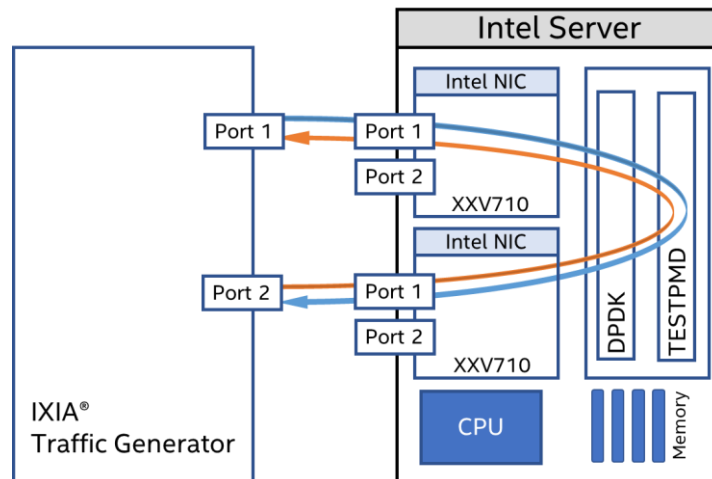
DPDK Performance Report
Release 20.11

Table 11: Test #4 Setting

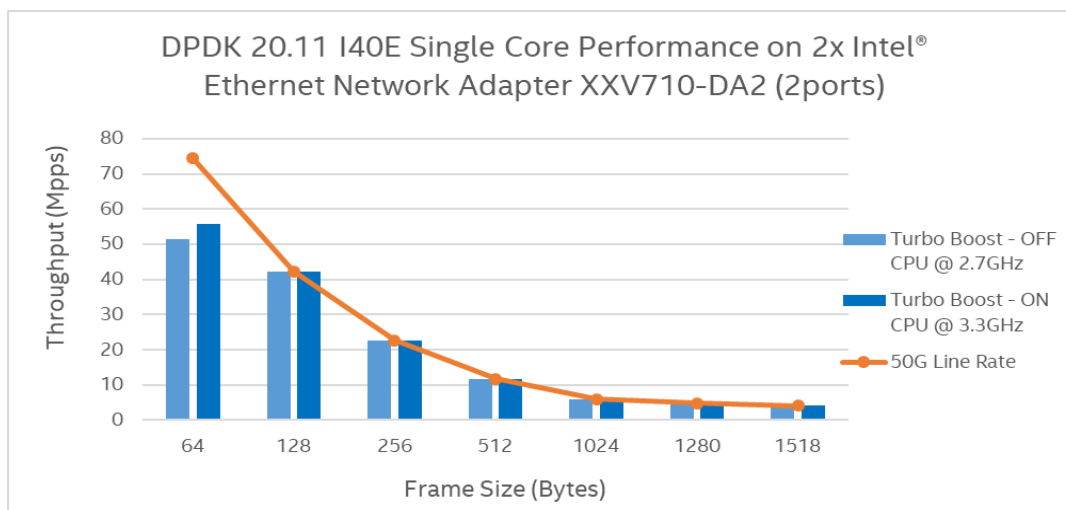| Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel® Hyper-Threading Tech Disabled
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21,28-48 nohz_full=1-21,28-48 rcu_nocbs=1-21,28-48
DPDK Settings	CC=gcc meson -Dlibdir=lib -Dexamples=l3fwd -Dc_args=-DRTE_LIBRTE_I40E_16BYTE_RX_DESC --default-library=static x86_64-native-linuxapp-gcc
Command line	dpdk-testpmd -l 5,6 -n 6 -w 0000:18:00.0 -w 0000:1a:00.0 -- -i --portmask=0x3 --txd=2048 --rxd=2048 --txq=2 --rxq=2 --forward=io -a

Test Results

Table 12: Test #4 Result

Frame Size (Bytes)	Line Rate [2x25G] (Mpps)	Frame Rate (Mpps)	
		Turbo Boost – OFF CPU @ 2.7GHz	Turbo Boost – ON CPU @ 3.3GHz
64	74.40	49.56	53.79
128	42.23	42.23	42.23
256	22.65	22.65	22.65
512	11.75	11.75	11.75
1024	5.99	5.99	5.99
1280	4.81	4.81	4.81
1518	4.06	4.06	4.06

Note all packets over 128B reaches hardware limitation.

Figure 10: i40e PMD Single core performance on 2x Intel® Ethernet Network Adapter XXV710-DA2

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Test#5 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-CQDA2

Table 13: Test #5 Setup

Item	Description
Test Case	Test#5 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-CQDA2
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	1x Intel® Ethernet Network Adapter E810-CQDA2; PCIe 3.0/4.0 x16; (PCIe 3.0 was used in the test)
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Operating System	Ubuntu 20.04 LTS
Linux kernel version	5.4.0-40-generic
GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x1592
Intel NIC Firmware version	2.30 0x80005d1b 1.2877.0
Intel NIC Package	ice_comms-1.3.24.0.pkg
DPDK version	20.11
Test configuration	1 NIC card attached to the first processor. 1 port assigned per logical core using 1 queue. Totaling 4 logical cores, 4 queues for 1port.

Figure 11: Test #5 Setup – 1x Intel® Ethernet Network Adapter E810-CQDA2 connected to IXIA (Single port)
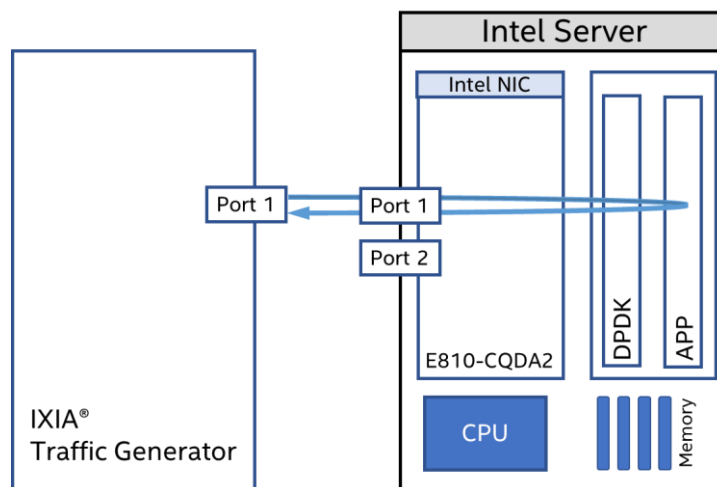
Table 14: Test #5 Setting

Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel(R) Hyper-Threading Tech Disabled Turbo Boost Disabled
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21 nohz_full=1-21 rcu_nocbs=1-21 idle=poll
DPDK Settings	CC=gcc meson -Dlibdir=lib -Dexamples=l3fwd -Dc_args=-DRTE_LIBRTE_ICE_16BYTE_RX_DESC --default-library=static x86_64-native-linuxapp-gcc
Command line	dpdk-l3fwd -l 5-8 -n 4 -w 18:00.0 -- -p 0x1 --config '(0,0,5),(0,1,6),(0,2,7),(0,3,8)'

Test Results

Table 15: Test #5 Result

Frame Size (Bytes)	Line Rate[100G] (Mpps)	Frame Rate (Mpps)	% Line Rate
64	148.81	109.05	73.28
128	84.46	74.96	88.75
256	45.29	44.97	99.29
512	23.50	23.50	100
1024	11.97	11.97	100
1280	9.62	9.62	100
1518	8.13	8.13	100

Figure 12: RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-CQDA2
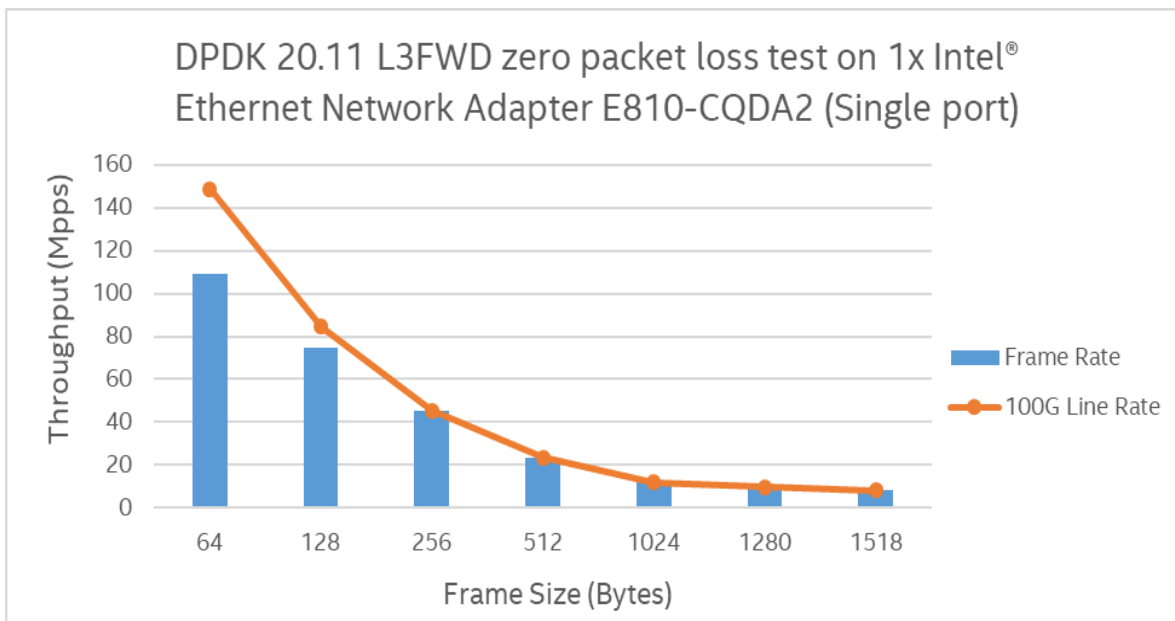
Test#6 ice PMD Single core performance test

Table 16: Test #6 Setup

Item	Description
Test Case	Test#6 ice PMD Single core performance test
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	1x Intel® Ethernet Network Adapter E810-CQDA2; PCIe 3.0/4.0 x16; (PCIe 3.0 was used in the test)
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Operating System	Ubuntu 20.04 LTS
Linux kernel version	5.4.0-52-generic
GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x1592
Intel NIC Firmware version	2.30 0x80005d1b 1.2877.0
Intel NIC Package	ice_comms-1.3.24.0.pkg
DPDK version	20.11
Test configuration	1 NIC cards attached to the first processor and 1 port of the NIC is used. Each port has 1 queue assigned.

Figure 13: Test #6 Setup – 1x Intel® Ethernet Network Adapter E810–CQDA2 connected to IXIA (Single port)
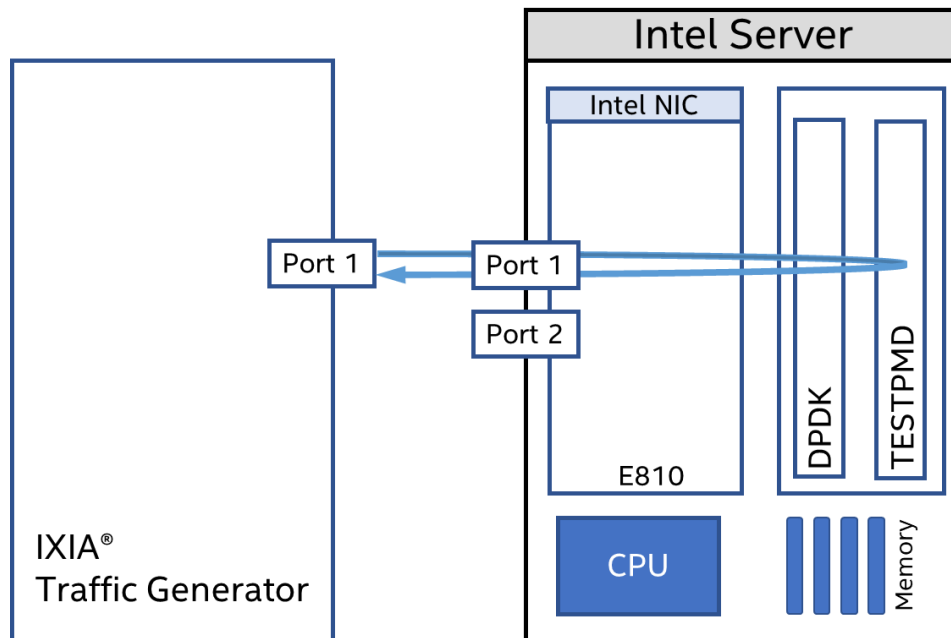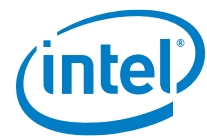
Table 17: Test #6 Setting

Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel® Hyper-Threading Technology Disabled Turbo Boost Disabled Enabled/Disabled (changed in the test)
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21 nohz_full=1-21 rcu_nocbs=1-21 idle=poll
DPDK Settings	CC=gcc meson -Dlibdir=lib -Dc_args=-DRTE_LIBRTE_ICE_16BYTE_RX_DESC --default-library=static x86_64-native-linuxapp-gcc
Command line	dpdk-testpmd -l 5,6 -n 6 -- -i --portmask=0x1 --rxq=1 --txq=1 --txd=1024 --rxd=1024 --forward=io -a add "--force-max-simd-bitwidth=512" if using AVX512, default is AVX2

Test Results

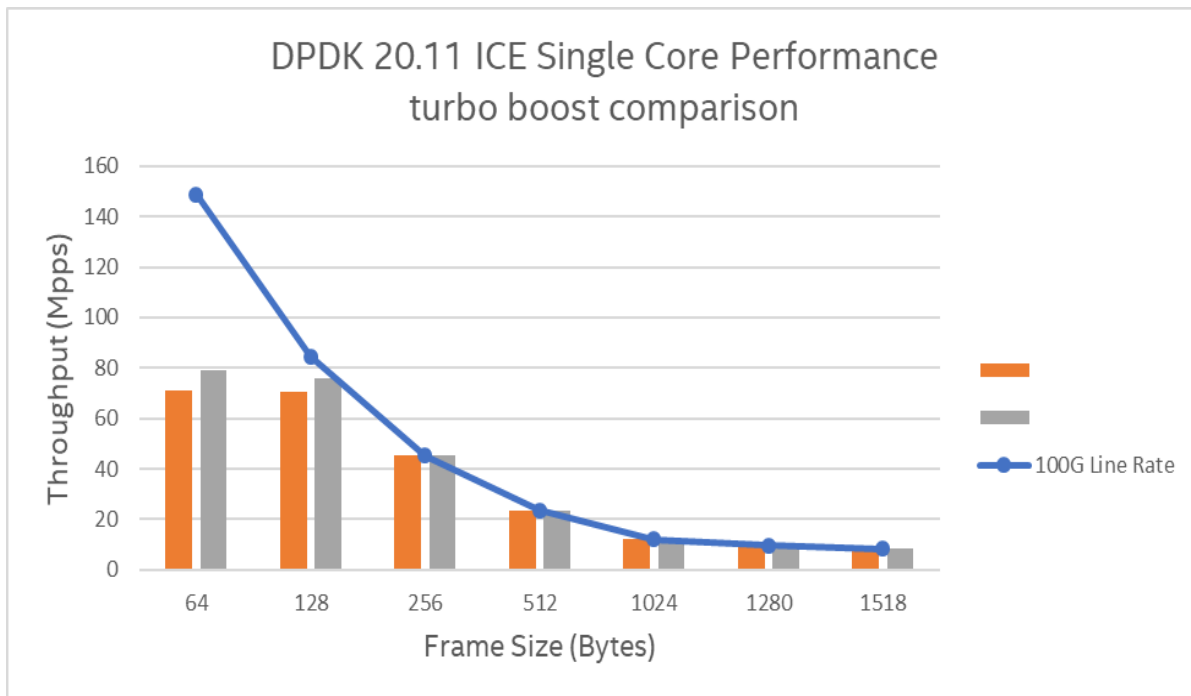### *Subcase #1: Turbo boost comparison*

Setting: using AVX2 instruction; hyper-threading disabled

Table 18: Test #6 Subcase #1 Result

Frame Size (Bytes)	Line Rate [100G] (Mpps)	Frame Rate (Mpps)	
		Turbo – OFF CPU @ 2.7GHz	Turbo – ON CPU @ 3.3GHz
64	148.81	71.45	79.75
128	84.46	70.51	75.52
256	45.29	45.29	45.29
512	23.50	23.50	23.50
1024	11.97	11.97	11.97
1280	9.62	9.62	9.62
1518	8.13	8.13	8.13

Note all packets over 256B reaches hardware limitation.

Figure 14: ice PMD Single core performance on 1x Intel® Ethernet Network Adapter E810-QCDA2 with turbo boost comparison
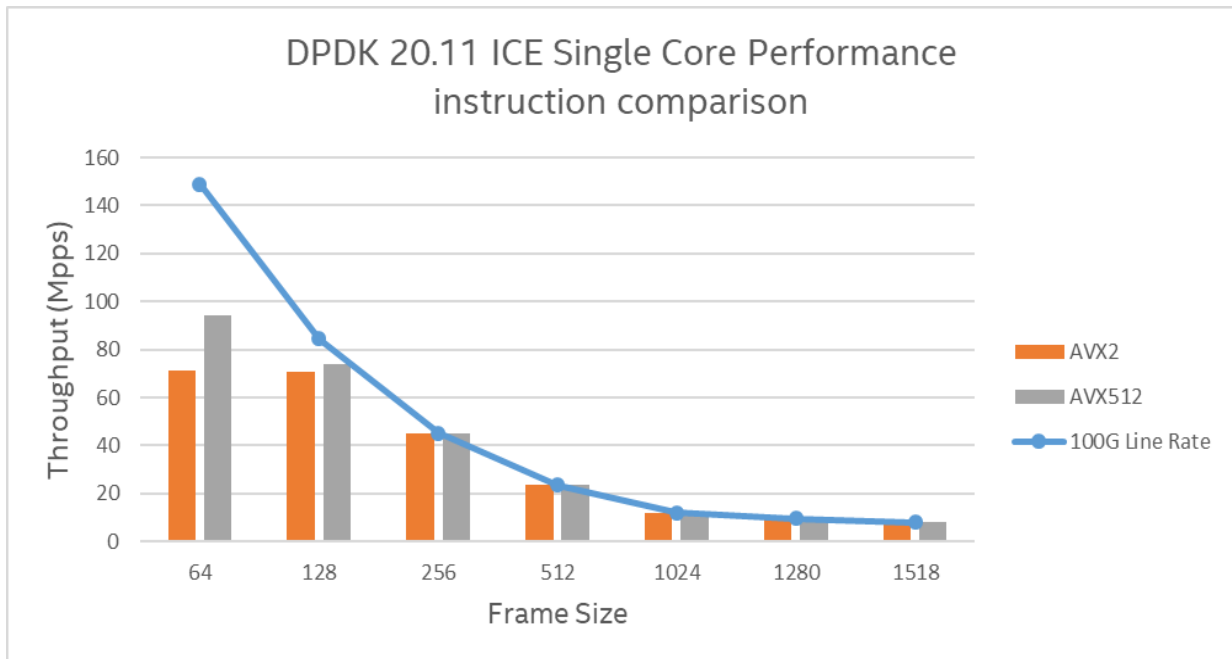
Subcase #2: Instruction comparison

Setting: turbo boost disabled; hyper-threading disabled

Table 19: Test #6 Subcase #2 Result

Frame Size (Bytes)	Line Rate [100G] (Mpps)	20.11 – CLX – CPU @ 2.7GHz		
		AVX2	AVX512	benefit %
64	148.81	71.11	94.44	32.81
128	84.46	70.50	73.86	4.77
256	45.29	45.29	45.29	0
512	23.50	23.50	23.50	0
1024	11.97	11.97	11.97	0
1280	9.62	9.62	9.62	0
1518	8.13	8.13	8.13	0

Note 64Bytes increase 32%, all packets over 256B reaches hardware limitation.

Figure 15: ice PMD Single core performance on 1x Intel® Ethernet Network Adapter E810-QCDA2 with instruction comparison

Subcase #3: Hyper-threading comparison

Setting: using AVX2 instruction; turbo boost disabled

Table 20: Test #6 Subcase #3 Result

Frame Size (Bytes)	Line Rate [100G] (Mpps)	20.11 - CLX - CPU @ 3.3GHz		
		1C/1T/1Q	1C/2T/2Q	benefit %
64	148.81	77.43	106.21	37.17
128	84.46	75.60	73.98	-2.13
256	45.29	45.29	45.29	0
512	23.50	23.50	23.50	0
1024	11.97	11.97	11.97	0
1280	9.62	9.62	9.62	0
1518	8.13	8.13	8.13	0

Note 64Bytes increase 37%, all packets over 128B reaches hardware limitation.

Figure 16: ice PMD Single core performance on 1x Intel® Ethernet Network Adapter E810-QCDA2 with hyper-threading comparison
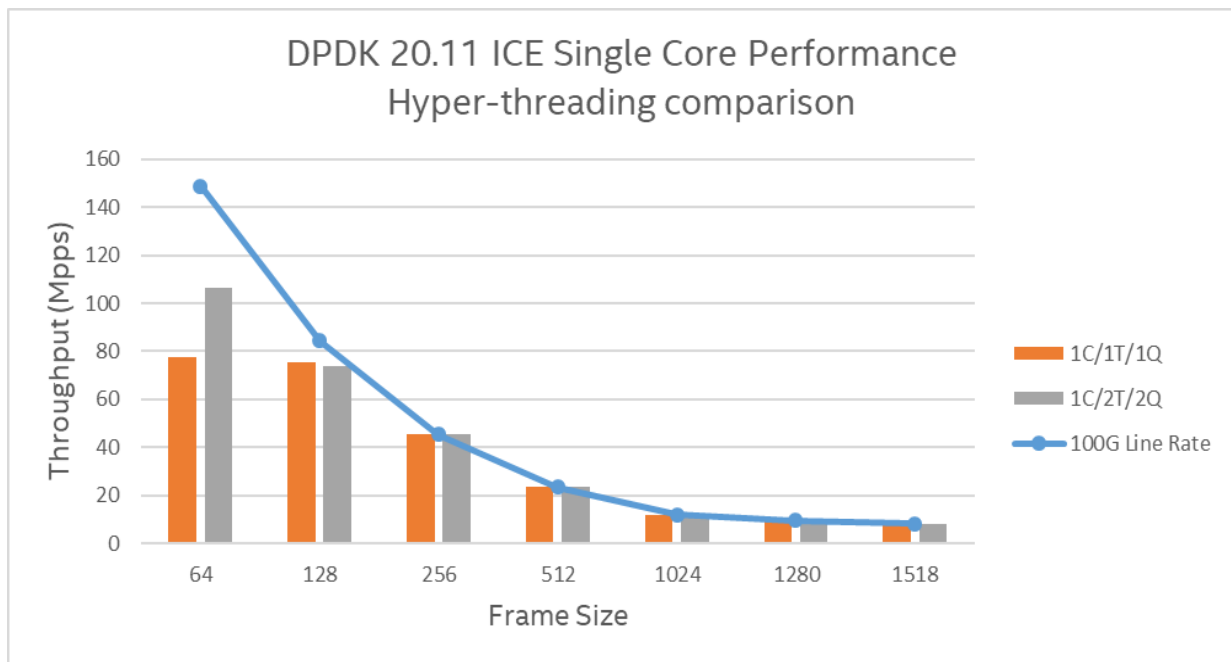
Test#7 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-CQDA2 using SRIOV over KVM

Table 21: Test #7 Setup

Item	Description
Test Case	Test#7 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-CQDA2 using SRIOV over KVM
Server Platform	Intel® Server Board S2600WFT
CPU	Intel(R) Xeon(R) Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	1x Intel® Ethernet Network Adapter E810-CQDA2; PCIe 3.0/4.0 x16; (PCIe 3.0 was used in the test)
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Hypervisor	Ubuntu 20.04 LTS QEMU emulator version 4.2.1 (Debian 1:4.2-3ubuntu6.8)
Hypervisor kernel version	5.4.0-52-generic
Hypervisor Intel Driver	ice-1.3.2
Guest Operating System	Ubuntu 20.04 LTS
Guest kernel version	5.4.0-52-generic
Guest GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x1592
Intel NIC Firmware version	2.30 0x80005d1b 1.2877.0
Intel NIC Package	ice_comms-1.3.24.0.pkg
DPDK version	20.11
Test configuration	1 NIC, 1 port generate 1 VF. VF has 4 queues, 1 queue per logical core. Totaling 4 logical cores, 4 queues for 1VF.

Figure 17: Test #7 Setup – 1x Intel® Ethernet Network Adapter E810-CQDA2 connected to IXIA (Single port)
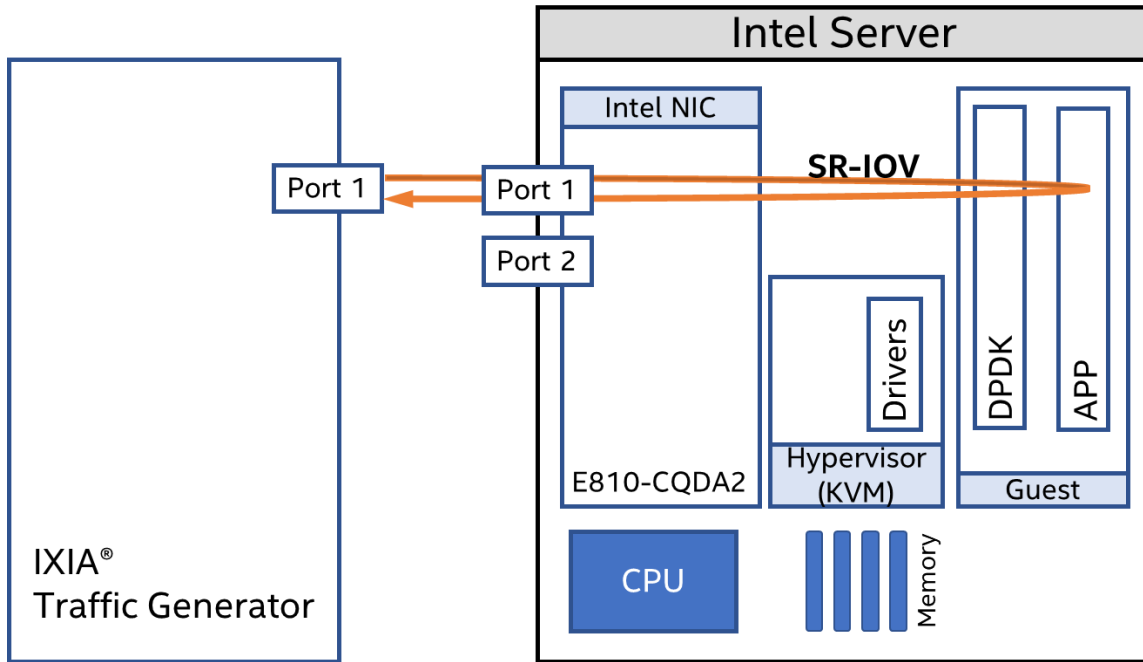
Table 22: Test #7 Setting

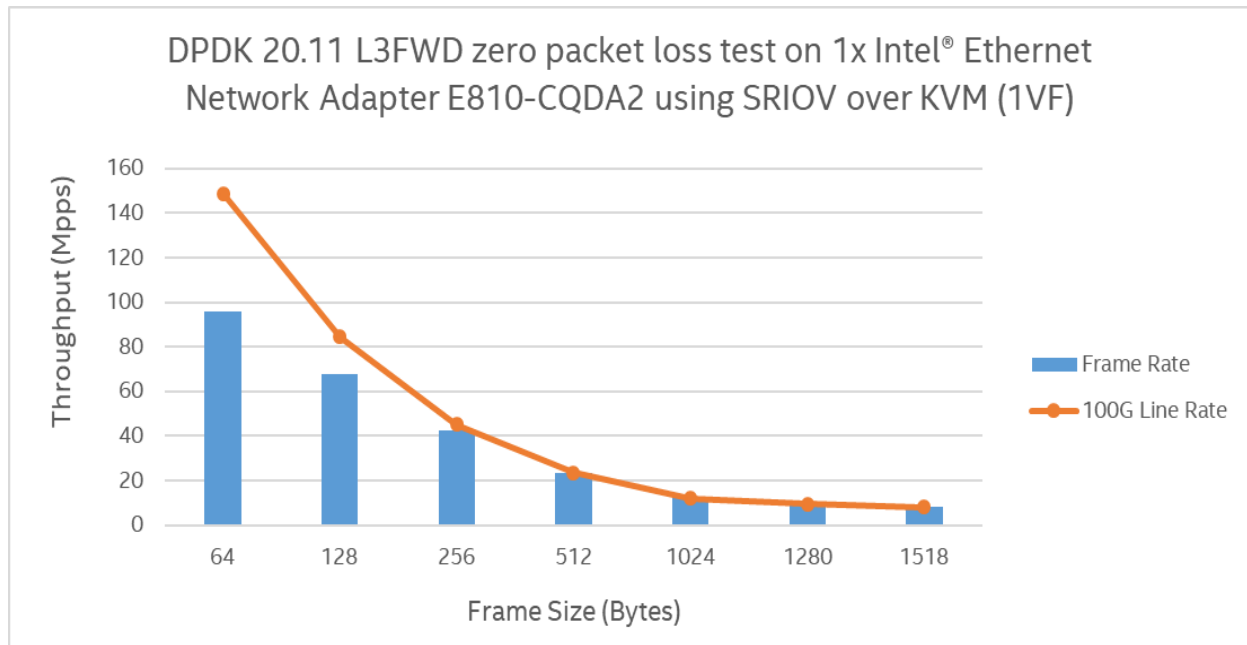| Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel® Hyper-Threading Tech Disabled Turbo Boost Disabled Intel® Virtualization Technology Enabled Intel® VT for Directed I/O Enabled
Hypervisor Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21 nohz_full=1-21 rcu_nocbs=1-21 intel_pstate=disable idle=poll

Hypervisor settings	1, creating VF
	echo 1 >/sys/bus/pci/devices/0000\:18\:00.0/sriov_numvfs
	
	2, setting VF MAC
	ip link set ens785f0 vf 0 mac A6:9C:BB:07:55:C0
	
	3, binding VF to vfio-pci
	./usertools/dpdk-devbind.py –b vfio-pci 0000:18:01.0
	
	4, mount hugepage
	mount -t hugetlbfs nodev /mnt/huge
	
	5, launch qemu
	qemu-system-x86_64 -name vm0 -enable-kvm --monitor stdio -monitor unix:/tmp/vm0_monitor.sock,server,nowait -device e1000,netdev=nttsip1 -netdev user,id=nttsip1,hostfwd=tcp:127.0.0.1:6013-:22 -device vfio-pci,host=0000:18:01.0,id=pt_0 -cpu host -m 32768 -object memory-backend-file,id=mem,size=32768M,mem-path=/mnt/huge,share=on -numa node,memdev=mem -mem-prealloc -smp cores=10,sockets=1 -chardev socket,path=/tmp/vm0_qga0.sock,server,nowait,id=vm0_qga0 -device virtio-serial -device virtserialport,chardev=vm0_qga0,name=org.qemu.guest_agent.0 -vnc :10 -drive file=/home/image/ubuntu2004.img,if=virtio,index=0,media=disk
	
	6, vcpu pinning
	6.1 get vcpu thread ids by qemu monitor
	(qemu) info cpus
	* CPU #0: thread_id=6106
	  CPU #1: thread_id=6107
	  CPU #2: thread_id=6108
	  CPU #3: thread_id=6109
	  CPU #4: thread_id=6110
	  CPU #5: thread_id=6111
	  CPU #6: thread_id=6112
	  CPU #7: thread_id=6113
	  CPU #8: thread_id=6114
	  CPU #9: thread_id=6115

	6.2 pin thread ids to logical cores taskset –pc 9 6115 taskset –pc 8 6114 taskset –pc 7 6113 taskset –pc 6 6112 taskset –pc 5 6111 taskset –pc 4 6110 taskset –pc 13 6109 taskset –pc 12 6108 taskset –pc 11 6107 taskset –pc 10 6106
Other optimizations on Hypervisor	echo -1 > /proc/sys/kernel/sched_rt_period_us echo -1 > /proc/sys/kernel/sched_rt_runtime_us echo 10 > /proc/sys/vm/stat_interval echo 0 > /proc/sys/kernel/watchdog_thresh
Guest Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=4-9 nohz_full=4-9 rcu_nocbs=4-9 intel_pstate=disable idle=poll processor.max_cstate=0 intel_idle.max_cstate=0
Other optimizations on Guest	echo 1 > /sys/module/vfio/parameters/enable_unsafe_noiommu_mode echo -1 > /proc/sys/kernel/sched_rt_period_us echo -1 > /proc/sys/kernel/sched_rt_runtime_us echo 10 > /proc/sys/vm/stat_interval echo 0 > /proc/sys/kernel/watchdog_thresh
DPDK Settings on Guest	CC=gcc meson -Dlibdir=lib -Dexamples=l3fwd --default-library=static x86_64-native-linuxapp-gcc
Command line on Guest	dpdk-l3fwd -l 4-7 -n 6 -w 00:04.0 -- -p 0x1 --config '(0,0,5),(0,1,6),(0,2,7),(0,3,4)' --parse-ptype

Test Results

Table 23: Test #7 Result

Frame Size (Bytes)	Line Rate [100G] (Mpps)	Frame Rate (Mpps)	% Line Rate
64	148.81	95.80	64.37
128	84.46	67.57	80.00
256	45.29	42.46	93.75
512	23.50	23.35	99.38
1024	11.97	11.97	100
1280	9.62	9.62	100
1518	8.13	8.13	100

Figure 18: RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-CQDA2 using SRIOV over KVM

Test#8 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810–XXVDA4

Table 24: Test #8 Setup

Item	Description
Test Case	Test#8 RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810- XXVDA4
Server Platform	Intel® Server Board S2600WFT
CPU	Intel® Xeon® Platinum 8280M CPU @ 2.70GHz 28 CPU cores * 2 NUMA nodes
Memory	384GB: 32GB x 6 DIMMs x 2 NUMA nodes @ 2666MHz
NIC	1x Intel® Ethernet Network Adapter E810-XXVDA4; PCIe 3.0/4.0 x16; (PCIe 3.0 was used in the test)
BIOS	SE5C620.86B.02.01.0008.031920191559
Microcode	0x5002f01
Operating System	Ubuntu 20.04 LTS
Linux kernel version	5.4.0-42-generic
GCC version	gcc version 9.3.0 (Ubuntu 9.3.0-10ubuntu2)
Intel NIC Device ID	0x1593
Intel NIC Firmware version	2.30 0x80005d18 1.2877.0
Intel NIC Package	ice_comms-1.3.24.0.pkg
DPDK version	20.11
Test configuration	1 NIC card attached to the first processor. 1 port assigned per logical core using 1 queue. Totaling 4 logical cores, 4 queues for 4ports

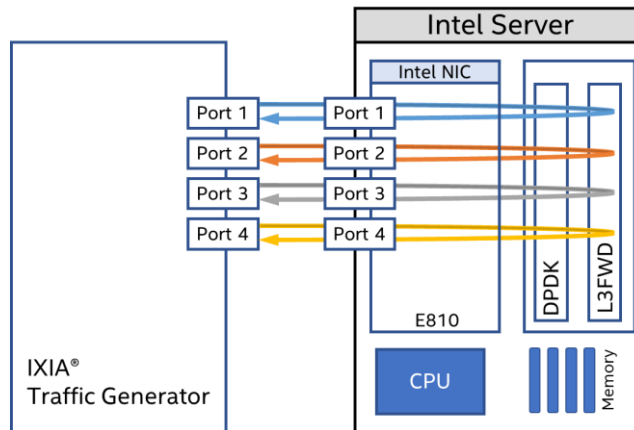**Figure 19: Test #8 Setup – 1x Intel® Ethernet Network Adapter E810–XXVDA4 connected to IXIA (4 ports of 1 NIC)**

Table 25: Test #8 Setting

Item	Description
BIOS	CPU Power and Performance Policy <Performance> CPU C-state Disabled CPU P-state Disabled Intel® Hyper-Threading Tech Disabled Turbo Boost Disabled
Boot settings	default_hugepagesz=1G hugepagesz=1G hugepages=16 intel_iommu=on iommu=pt isolcpus=1-21,28-48 nohz_full=1-21,28-48 rcu_nocbs=1-21,28-48
DPDK Settings	CC=gcc meson -Dlibdir=lib -Dexamples=l3fwd -Dc_args=-DRTE_LIBRTE_ICE_16BYTE_RX_DESC --default-library=static x86_64-native-linuxapp-gcc
Command line	dpdk-l3fwd -l 5-8 -n 6 –w 18:00.0 –w 18:00.1 –w 18:00.2 –w 18:00.3 -- -p 0xf --config '(0,0,5),(1,0,6),(2,0,7),(3,0,8)'

Test Results

Table 26: Test #8 Result

Frame Size (Bytes)	Line Rate [4x25G] (Mpps)	Frame Rate (Mpps)	% Line Rate
64	148.81	109.05	73.28
128	84.46	74.96	88.75
256	45.29	45.29	100
512	23.50	23.50	100
1024	11.97	11.97	100
1280	9.62	9.62	100
1518	8.13	8.13	100

Figure 20: RFC2544 zero packet loss test on 1x Intel® Ethernet Network Adapter E810-XXVDA4
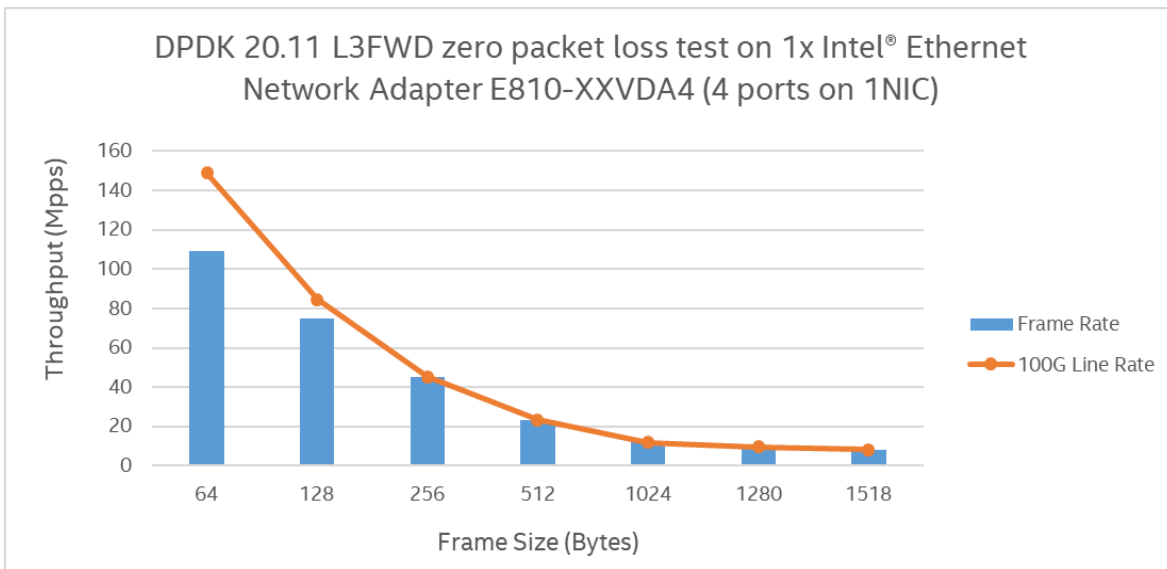
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