Xelera Net

High-performance Datacenter Networks with SmartNIC Technology

IPsec Performance Benchmark Report

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1 Introduction

The performance of the network infrastructure, particularly in terms of network throughput and meeting the technical requirements of the security architecture, is crucial to the overall quality of service (QoS) of the data center. Xelera Net is a SmartNIC solution tailored to these needs, combining the following features:

- Dataplane network functions with a guaranteed throughput of 100 Gbps (full-duplex)
- Network security functions, such as IPsec, with a guaranteed throughput of 100 Gbps (full-duplex)
- Current expansion to 400 Gbps networks
- Upcoming Connection to remote storage for AI clusters and Neo Clouds
- Upcoming peer-to-peer connection establishment to GPUs and other AI accelerators

Xelera Net is a SmartNIC software suite that works with COTS FPGA-based platforms. The solution is compatible with FreeBSD and Linux operating systems.

This report describes the test setup and results of the **IPsec** performance benchmark. The benchmark evaluates the **Gateway Mode Flavor** of the Xelera Net SmartNIC solution, i.e. it performs IPsec encryption and decryption between two network ports of the SmartNIC card.

2 Xelera Net- IPsec Product Specification

Feature	Specification
Cryptography	AES-GCM 128/256, 12/16 Byte ICV (RFC 4303)
IPsec throughput	Full-duplex 100Gbps Encryption and Decryption
IPsec sessions	16384 Sessions - Encryption 16384 Sessions - Decryption
IPsec modes	Tunnel Mode and Transport Mode
Virtualization	SR-IOV
Extended traffic selection	Route-based IPsec using XFRM devices (Linux) VTI (FreeBSD) Custom lookup with 16bit policy key
QoS	SA-transparent PMTUD support Active port fail-over support
Trusted Platform Support / Secure Boot	FPGA Bitstream encryption FPGA Bitstream authentication
Driver	Linux Kernel versions 5.15 - 6.18, FreeBSD versions 13.x - 14.x
Internet Key Exchange	Compatible with strongSwan via plugin
Network interface	2x100G

3 Test Setup

The DUT (Device Under Test) is an AMD Alveo U45N card (SmartNIC). The SmartNIC receives unencrypted traffic from Xena Z400qc Thor Network Analyzer, encrypts it and forwards it at its second network port to a second AMD Alveo U45N card. The second card decrypts the traffic again and sends it back to the Network Analyzer at its second network port. The analyzer verifies the integrity of the traffic data and measures the throughput for different packet sizes and the two-card latency. Figure 1 shows the test setup.

The Network Analyzer performs the benchmark according to the RFC2544 specification.

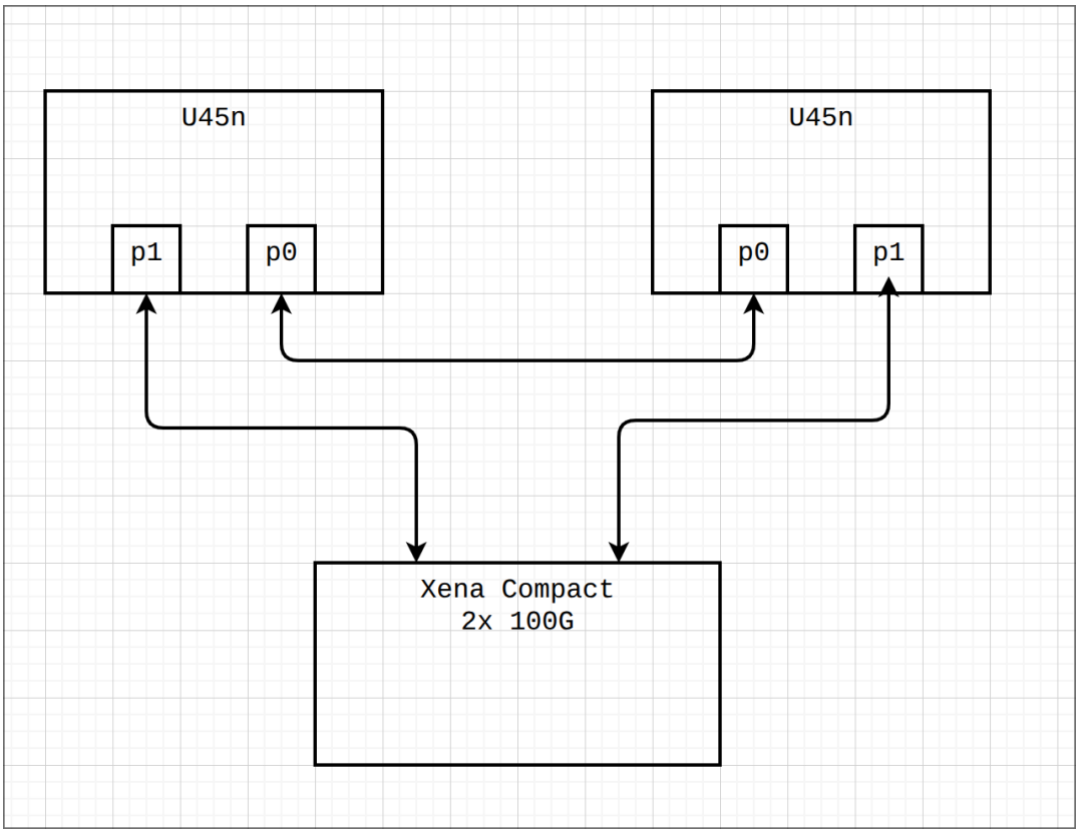

Figure 1: Test setup with Xena Z400qc Thor Network Analyzer

4 RFC2544 Test Results

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Xena2544 Test Report

Test Summary

Test company:	Teledyne LeCroy
Customer:	Xelera Technologies GmbH
Test Date and Time:	2026-02-12, 11:43
Test Duration:	00:18:02 (h:m:s)
Generated By:	Xena2544 v2.97, running on 'Microsoft Windows 11'

Test Setup

Test Configuration

Main Test Options

Topology:	Pairs
Direction:	West-to-East
Frame Size Type:	Custom Sizes
Frame Sizes Used:	68,128,256,512,1024,1280,1400,1500
Toggle Port Sync:	No
Sync Off Duration:	1 seconds
Sync On Delay:	2 seconds
Flow Creation Type:	Stream-based
Enable Multi-Stream:	No

Test Type Selection

Throughput Test:	Enabled
Latency and Jitter Test:	Disabled
Frame Loss Rate Test:	Disabled
Back-to-Back Test:	Disabled

Port Configuration

Used Port Count: 2

Used Chassis Summary

Chassis ID	Chassis Name	Chassis Serial#	Address and Port
C-0	Xena	7316682	127.0.0.1:22606

Used Ports Summary

Port ID	Interface Type	Port Group	Port Peer	Port Speed	Port Rate
P-0-0-0	QSFP28 100G CR4	West	P-0-0-1	100 Gbit/s	100 G
P-0-0-1	QSFP28 100G SR4	East	P-0-0-0	100 Gbit/s	100 G

Port Traffic Setup

Port ID	IP Address & Gateway	Protocol Segment Profile
P-0-0-0	192.168.88.21/24 (192.168.88.41)	5: Ethernet / IPv4 / UDP (S:5000/D:0)
P-0-0-1	192.168.89.31/24 (192.168.89.51)	5: Ethernet / IPv4 / UDP (S:5000/D:0)

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Throughput Test Results

Test Setup

Time Duration:	5 Seconds
Iterations:	1
Initial Rate:	100.000 %
Maximum Rate:	100.000 %
Minimum Rate:	0.100 %
Resolution:	0.500 %
Use Pass Threshold:	No
Pass Threshold:	0.000 %
Acceptable Loss:	0.0000 %
Rate Result Scope:	Common Result
Use Fast Binary Search:	No

Test Results

Test Results Summary

Total tests executed: 8

Success: All tests passed!

Detailed Test Results

Frame Size	**68**	**128**	**256**	**512**
Result State	PASS	PASS	PASS	PASS
Tx Off.Rate (Percent)	24.295 %	39.123 %	66.05 %	93.756 %
Tx (Frames)	172,543,686	165,215,660	149,565,320	110,145,472
Tx Rate (L1) (Bit/s)	24.2941509888 G	39.123068288 G	66.048045312 G	93.7558257664 G
Tx Rate (L2) (Bit/s)	18.7727530368 G	33.836167168 G	61.261955072 G	90.2311706624 G
Tx Rate (Fps)	34,508,737	33,043,132	29,913,064	22,029,094
Rx (Frames)	172,543,686	165,215,660	149,565,320	110,145,472
Loss (Frames)	0	0	0	0
Loss Rate (Percent)	0 %	0 %	0 %	0 %
BER (est)	0	0	0	0
P-0-0-0				
- Tx (Frames)	172,543,686	165,215,660	149,565,320	110,145,472
- Tx Rate (L1) (Bit/s)	24.2941509888 G	39.123068288 G	66.048045312 G	93.7558257664 G
- Tx Rate (L2) (Bit/s)	18.7727530368 G	33.836167168 G	61.261955072 G	90.2311706624 G
- Tx Rate (Fps)	34,508,737	33,043,132	29,913,064	22,029,094
- Rx (Frames)	0	0	0	0
- Rx Rate (L1) (Bit/s)	0	0	0	0
- Rx Rate (L2) (Bit/s)	0	0	0	0
- Rx Rate (Fps)	0	0	0	0
- Avg Latency (micsec)	N/A	N/A	N/A	N/A
- Min Latency (micsec)	N/A	N/A	N/A	N/A
- Max Latency (micsec)	N/A	N/A	N/A	N/A
- Avg Jitter (micsec)	N/A	N/A	N/A	N/A
- Min Jitter (micsec)	N/A	N/A	N/A	N/A
- Max Jitter (micsec)	N/A	N/A	N/A	N/A
P-0-0-1				
- Tx (Frames)	0	0	0	0
- Tx Rate (L1) (Bit/s)	0	0	0	0
- Tx Rate (L2) (Bit/s)	0	0	0	0
- Tx Rate (Fps)	0	0	0	0
- Rx (Frames)	172,543,686	165,215,660	149,565,320	110,145,472
- Rx Rate (L1) (Bit/s)	24.2941509888 G	39.123068288 G	66.048045312 G	93.7558257664 G
- Rx Rate (L2) (Bit/s)	18.7727530368 G	33.836167168 G	61.261955072 G	90.2311706624 G
- Rx Rate (Fps)	34,508,737	33,043,132	29,913,064	22,029,094
- Avg Latency (micsec)	3.507	3.570	3.739	4.072
- Min Latency (micsec)	3.479	3.543	3.663	3.903
- Max Latency (micsec)	3.543	3.599	3.767	4.103
- Avg Jitter (micsec)	0.005	0.004	0.005	0.004

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- Min Jitter (micsec)	0.000	0.000	0.000	0.000
- Max Jitter (micsec)	0.032	0.032	0.072	0.088

Frame Size	**1024**	**1280**	**1400**	**1500**
Result State	PASS	PASS	PASS	PASS
Tx Off.Rate (Percent)	96.488 %	97.268 %	97.659 %	97.659 %
Tx (Frames)	57,763,264	46,763,472	42,983,328	40,155,616
Tx Rate (L1) (Bit/s)	96.4877561856 G	97.26802176 G	97.658121216 G	97.658458112 G
Tx Rate (L2) (Bit/s)	94.6393317376 G	95.771590656 G	96.28265472 G	96.3734784 G
Tx Rate (Fps)	11,552,653	9,352,694	8,596,666	8,031,123
Rx (Frames)	57,763,264	46,763,472	42,983,328	40,155,616
Loss (Frames)	0	0	0	0
Loss Rate (Percent)	0 %	0 %	0 %	0 %
BER (est)	0	0	0	0
P-0-0-0				
- Tx (Frames)	57,763,264	46,763,472	42,983,328	40,155,616
- Tx Rate (L1) (Bit/s)	96.4877561856 G	97.26802176 G	97.658121216 G	97.658458112 G
- Tx Rate (L2) (Bit/s)	94.6393317376 G	95.771590656 G	96.28265472 G	96.3734784 G
- Tx Rate (Fps)	11,552,653	9,352,694	8,596,666	8,031,123
- Rx (Frames)	0	0	0	0
- Rx Rate (L1) (Bit/s)	0	0	0	0
- Rx Rate (L2) (Bit/s)	0	0	0	0
- Rx Rate (Fps)	0	0	0	0
- Avg Latency (micsec)	N/A	N/A	N/A	N/A
- Min Latency (micsec)	N/A	N/A	N/A	N/A
- Max Latency (micsec)	N/A	N/A	N/A	N/A
- Avg Jitter (micsec)	N/A	N/A	N/A	N/A
- Min Jitter (micsec)	N/A	N/A	N/A	N/A
- Max Jitter (micsec)	N/A	N/A	N/A	N/A
P-0-0-1				
- Tx (Frames)	0	0	0	0
- Tx Rate (L1) (Bit/s)	0	0	0	0
- Tx Rate (L2) (Bit/s)	0	0	0	0
- Tx Rate (Fps)	0	0	0	0
- Rx (Frames)	57,763,264	46,763,472	42,983,328	40,155,616
- Rx Rate (L1) (Bit/s)	96.4877561856 G	97.26802176 G	97.658121216 G	97.658458112 G
- Rx Rate (L2) (Bit/s)	94.6393317376 G	95.771590656 G	96.28265472 G	96.3734784 G
- Rx Rate (Fps)	11,552,653	9,352,694	8,596,666	8,031,123
- Avg Latency (micsec)	4.636	4.927	5.076	5.175
- Min Latency (micsec)	4.359	4.591	4.703	4.807
- Max Latency (micsec)	4.663	4.959	5.103	5.215
- Avg Jitter (micsec)	0.003	0.004	0.004	0.004
- Min Jitter (micsec)	0.000	0.000	0.000	0.000
- Max Jitter (micsec)	0.272	0.336	0.288	0.320