# Ultimate IP cores
## for Vertical Market Solutions

**DesignGateway is
the Titanium Partner
of Intel® Partner Alliance**

intel. partner Titanium

**Storage IPs
Networking IPs
Security IPs**

**All pure hardware logic
No CPU & external memory required
Proven by Real board
High performance & High reliability
Compact resource & Simple user interface**

■ **Support the Latest Devices**
Intel high-performance FPGA Agilex™ is abailable

intel. AGILEX

■ **Ready to Evaluate on Real FPGA Boards**
Able to evaluate IP core performance before purchasing
and watch performance demo on Youtube

■ **Reference Design provided together with IP core License**
Able to start development from the design bit by bit
to shorten time and reliable development

■ **Rich Technical Documents**
All technical information are publicly available on official website

DESIGN GATEWAY COMPANY LIMITED

# NVMe IP core Series

## Direct Connect up to PCIe Gen5 SSD with Agilex™ FPGA R-Tile

NVMe IP core series is standalone NVMe Host Controller with built-in optimized PCIe Bridge and Internal Memory Buffer, designed to handle NVMe Protocol without CPU/OS and External DDR memory.

NVMe IPcore series are recommended for the application which requires GB/sec order high-speed, Tera Byte order high-storage capacity, very compact system size and easily to support multiple NVMe SSDs.

Free evaluation sof files for Intel® FPGA boards are available. You can evaluate IP core performance before purchasing.

## Features

- Implement application layer to access PCIe SSD **without CPU and external memory**
- Support SMART, Shutdown, FLUSH command
  * Optional Support: Elase, Write Zero, Sanitize command
- **exFAT/FAT32** access without CPU  * optional
- Support PCIe switch  * customize support
- Free evaluation **before** purchasing

No CPU & External DDR
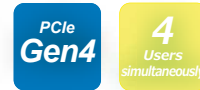
Simple Interface

Rich Documents

Proven Reference design
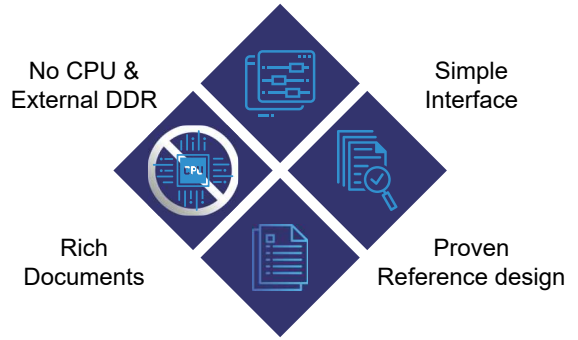
## Line up & Options

### NVMe IP core

NVMe IP core supports PCIe Gen5 SSD with Intel®Agilex™ 7 I-series FPGA.

- PCIe Gen5
- 2ch/4ch RAID
- ex FAT

### NVMe G3 IP core
*built-in PCIe Gen3 Soft IP*

NVMeG3 IP core with PCIe Soft IP is suitable for non-embedded PCIe Hard IP FPGA Devices.

- PCIe Gen3
- No Need PCIe Hard IP

### muNVMe IP core
MULTI USER

muNVMe IP core is optimized for multiple data stream access by multiple users simultaneously.

- PCIe Gen4
- 4 Users simultaneously

### rmNVMe IP core
*Random Access & Multi User*

rmNVMe IP core is highly optimized random access by multiple users simultaneously.

- PCIe Gen5
- 2600K IOPS

## Ultra High-Performance by 4ch RAID0 on Agilex

NVMe IP core 4ch RAID — **Write Gen5** — **40 GB/s**
NVMe IP core 4ch RAID — Gen4 — **21 GB/s**
NVMe IP core 4ch RAID — Gen3 — **8 GB/s**

0    10    20    30    **40** GB/s
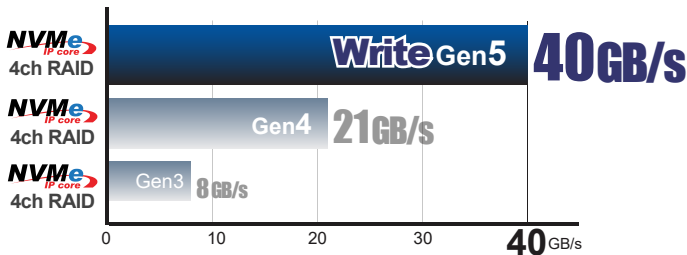
* NVMe IP (Gen5) with Gigabyte Aorus 10000, CFD Gaming, Crucial T700
* NVMe IP (Gen4) with WD Black SN850 4pcs
* NVMe IP (Gen3) with Samsung 960Pro 2pcs + 970Pro 2pcs

NVMe-IP PCIe Gen5 4ch RAID0 Evaluation on Intel®Agilex™7 I-series FPGA Dev Kit

## Suitable Applications

**MANUFACTURING & EQUIPMENT**
Data Logger

**TEST & MEASUREMENT**
4K/8K Display tester Image Measuring Device

**AUTOMOTIVE**
LiDAR

**MEDICAL**
High resolution CT scanner

**AEROSPACE**
Satellite tracking station

**BROADCASTING & MEDIA**
4K/8K Video Recording System

**Design Gateway Co.,Ltd.**

# NVMeTCP
## IP CORE SERIES

# CPU-less NVMe Over Fabric (NVMe/TCP) Initiator IP

NVMeTCP25G IP Evaluation on Intel®Agilex™F series FPGA dev kit

**NVMeTCP IP** core series is the standalone host side NVMe Over TCP (NVMe/TCP) controller with no CPU and external memory required. Enabling very high-performance remote access to NVMe-oF Storage Server by simple user logic. Greatly reduce design complexity and development time. Allowing your FPGA Card/Board to get access to the existing NVMe-oF storage infrastructure remotely and directly over FPGA's network interface with maximum possible performance.

This IP license includes reference design for Intel® FPGA. It helps you to reduce development time. DesignGateway provide demo file for Intel FPGA boards. You can evaluate NVMeTCP-IP cores on real board before purchasing.
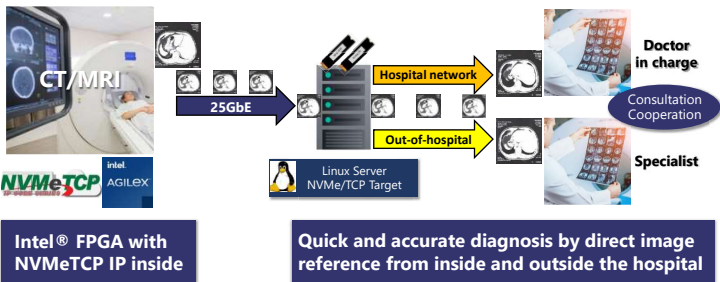
# Merits & Advantages

- Simply attach the remote NVMe-of storage server to FPGA Card/Board without PCIe hard IP and/or SoC

- Very high performance with over 95% network band-width utilization

- Enabling NVMe/TCP host side on FPGA with no CPU and DDR

- Scalable storage capacity & performance with multiple IPs implementation
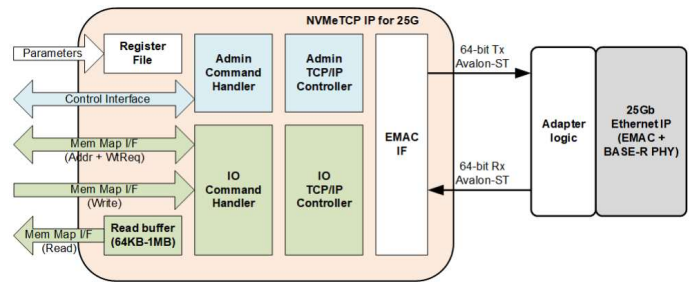
**Block diagram** * NVMeTCP25G-IP

# Example Applications

## Remote Image Data Storage for Medical Equipment

CT/MRI

25GbE

NVMeTCP AGILEX

Hospital network

Out-of-hospital

Linux Server NVMe/TCP Target

Doctor in charge

Consultation Cooperation

Specialist

**Intel® FPGA with NVMeTCP IP inside**

**Quick and accurate diagnosis by direct image reference from inside and outside the hospital**

Remote Data Logger for Manufacturing

Remote Data Logger for Test equipment

Remote Data Storage for Medical

Remote Data Storage for Broadcasting

# Performance

A10 SoC + 10G EMAC
CPU Usage > 50%
~400MB/s
~600MB/s

NVMeTCP10G x 1
1,186MB/s
1,128MB/s

NVMeTCP25G x 1
2,742MB/s
2,625MB/s

NVMeTCP25G x 4
~9,500MB/s
~9,000MB/s

CPU Usage
Read (MB/s)
Write(MB/s)

**CPU Usage 0%**
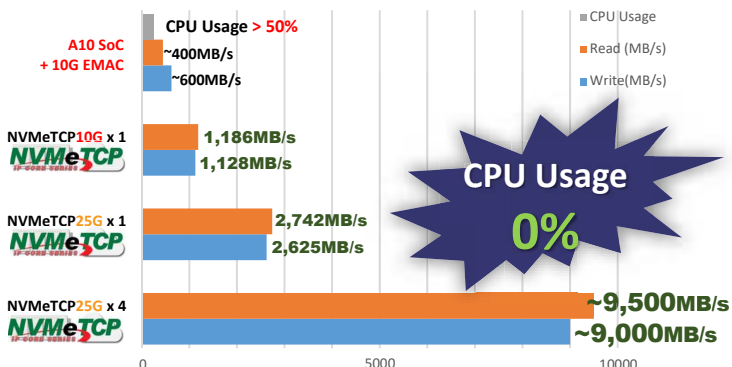
Using multiple NVMe TCP IP cores allows simultaneous transfer of each data stream to individual SSDs.

This IP aids in developing applications that fully leverage the high-speed 10Gbit and 25Gbit Ethernet bandwidth alongside the outstanding performance of NVMe SSDs.

For more detail and technical information on our web site https://dgway.com/NVMeTCP-IP_A_E.html

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## TOE xxG IPcore series
### TCP Offloading Engine IP Core

# Fully CPU offload for TCP/IP Transmission for up to 100GbE

**TOE100G/40G/25G/10G/1G-IP (TCP Off-loading Engine IP core series)** is the epochal solution implemented without CPU. Generally, TCP processing is so complicated that expensive high-end CPU is required. TOE IP core series built by pure hardwired logic can take place of such extra CPU for TCP protocol management. This IP product includes reference design which helps you to reduce development time. DesignGateway provide demo binary file for Intel®FPGA boards. You can evaluate TOE-IP cores on real board before purchasing.

## Features  [No Need CPU] [Up to 100G]

- Over 12GByte/sec real transfer speed
  *_* End-to-End TOE100G-IP_
- Support Full Duplex
- Easy to build CPU-less network system
- Small resource consumption
- Support Multi-Session
- Free evaluation before purchasing

### Intelligent & Enhanced Tx/Rx Function

**FPGA Tx**
- Automatic Tx packet generation
- Automatic acquire MAC address of target
- Support both Server and Client mode
- Automatic retransmission by timeout or Duplicate-ACK

**FPGA Rx**
- Packet filtering to permit target packet only
- Automatic ACK return at ARP receiving
- Duplicate-ACK transmission by Rx packet error detection
- Data reordering based on sequence No. of Rx packet

## Application Examples

CT scanner

Satellite base Station system

Industrial Printer

ECU Evaluation device

## UDP xxG IPcore series
### User Datagram ProtocolIP Core

# Ideal for Network applications that Require Broadcast and Low latency

**UDP100G/40G/25G/10G/1G IP** core are the epochal solution implemented without CPU and supports High-speed Full Duplex. UDP-IP core series is suitable for network applications that require broadcast and low latency.

## Features  [No Need CPU] [Up to 100G]

- All pure HW logic, Minimum overhead
- Support Full Duplex
- Support Broadcast/Multicast Tx
- Free evaluation before purchasing

intel AGILEX

UDP100G IP Evaluation
on Intel®Agilex™F series FPGA dev kit

## Application Examples

Wireless Communication system

Radar system

Marine sonar

Network game Console

Delay Tolerant Network (DTN) Investigation

**Design Gateway Co.,Ltd.**

## CPU-less TLS1.3 Offload IP core Suitable for Mission-critical applications

TLS1.3 IP (Transport Layer Security v1.3 IP) is the CPU-less & High-performance TLS v1.3 protocol engine for FPGA Acceleration. Providing maximum Gigabit Ethernet throughput for highly secure data transmission over 1G/10G/25G/100G network. Protect your valuable data from potential security breaches by using TLS secure transmission now! Especially, in Industrial IoT & Automation, Aerospace & Defense Applications.

- CPUless & No external memory required
- Key exchange : X25519
- Derive key : HKDF with SHA384
- Encryption/decryption : AES256GCM
- Self-signed Certificate : RSA2048

## High throughput for Secure Storage applications

AES256-XTS IP implement the advanced encryption standard (AES) with XEX Tweakable Block Cipher with Ciphertext Stealing (XTS) which is widely used in protecting the confidentiality of data on storage devices.

AES256-XTS-STG IP is widely used in protecting the confidentiality of data on various storage devices with interfaces such as NVMe. "2X" ideal for NVMe PCIe Gen4, and "4X", supported Gen5.

### AES256-XTS IP

- Support AES-XTS mode
- Support 256-bit key size
- Support input data width128-bit
- Support Ciphertext Stealing
- Peak throughput rate at 128 Mbits/MHz
- High-throughput, up to 44.8Gbps @350MHz

**Introduction Video on YouTube**

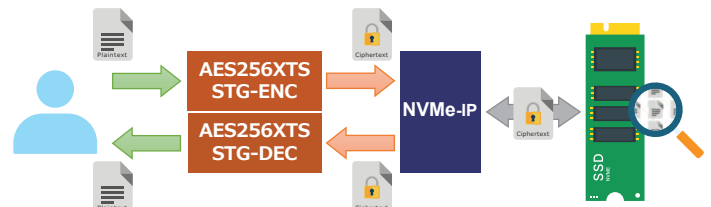AES256-XTS-STG-4X IP + NVMe-IP PCIe Gen5 Evaluation demo

### AES256-XTS-STG IP

- Support AES-XTS mode
- Support 256-bit key size
- Support input data width128-bit
- Support Auto Increment Iv every 512-byte Mode
- Peak throughput rate at512Mbits/MHz (AES256-XTS-STG-4X IP)
- High-throughput, up to 204.8Gbps @400MHz (AES256-XTS-STG-4X IP)

STG PCIe Gen3 | STG-2X PCIe Gen4 | STG-4X PCIe Gen5



**Over 10GB/sec** Secure write with NVMe-IP core

## High throughput for Secure Communication applications

AES256-GCM IP implement the advanced encryption standard (AES) with 256-bit key in Galois/Counter Mode (GCM) which is widely used for Authenticated Encryption with Associated Data (AEAD) application. This IP is suitable to work together with Low Latency TOE10G IP core for high performance, low latency and secure communication applications.

- Support AES-GCM mode standard
- Support 256-bit key size, 96-bit iv size
- Support zero-length AAD or data input.
- Peak throughput rate at 512 Mbits/MHz (AES256-GCM-100G IP)
- High-throughput 112.64 Gbps @220MHz (AES256-GCM-100G IP)

AES256-GCM 10G/25G | AES256-GCM 100G

**Introduction Video on YouTube**
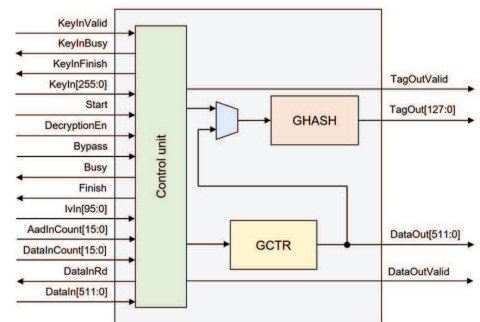


AES256-GCM-100G IP Block diagram

For more detail and technical information on our web site https://dgway.com/IPcores.html#SecurityIP

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## ▶ Technical Documents on Website



Document download is available on NVMe-IP page
(https://dgway.com/NVMe-IP_A_E.html)

Please check the latest information and documents of IP cores on the Design Gateway Website.

### ▶ Technical Documents
Datasheet
Reference Design Document
Demo Instruction

### ▶ Free Evaluation Demo Files
\* Easy registration required to obtain password

**sof file**

### ▶ Evaluation Demo Video
https://www.youtube.com/user/DGIPcore
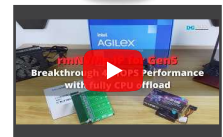
### ▶ Sales Materials
Brochure
Presentation

## ▶ Performance Evaluation Demo on YouTube

Degign Gateway IP cores Performance evaluation demo on real FPGA boards are available onYouTube. Watching video clips to learn how to evaluate free evaluation demo files with your FPGA development kit.

**YouTube** | designgateway IPcore | 検索

### Recommended contents

NVMe-IP PCIe Gen5 4ch RAID0 demo
on Intel® Agilex™7 I-series dev kit

NVMe-IP PCIe Gen4 4ch RAID0 demo
on Intel® Agilex™7 F-series dev kit

rmNVMe-IP PCIe Gen5 demo
on Intel® Agilex™7 I-series dev kit

muNVMe-IP 4 users performance demo
on Intel® Agilex™7 F-series dev kit

TOE100G-IP performance demo
on Intel® Agilex™7 F-series dev kit

UDP100G-IP performance demo
on Intel® Agilex™7 F-series dev kit

AES256-XTS-STG-4X IP
+ NVMe-IP PCIe Gen5 demo

tCAM IP
performance demo

## ▶ News & Articles

Design Gateway uses social media to provide you with the latest information in an easy-to-understand manner. Please visit from icons in the header of the website.

**IP core simple introduction**
Just a minute to understand DG products by Picture-story show style blog.

**Design Gateway's Technology Blog**
Technology introduction articles related to DG products.

**Design Gateway Hot! News Backnumber**

**Design Gateway LinkedIn**

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## Design Gateway provides Key functions for next-generation product development

High-speed data transmission over **40GByte/sec** ◆ Ultra-low latency at the **NANO** second level ◆ Ultra-high-speed processing **without CPU**

### Aerospace

Space exploration system
Satellite tracking station
Base station system
Radar system
Marine sonar

### Automotive

LiDAR
Pedestrian radar
ECU evaluation device

### Broadcasting & Media

4K/8K Video Recording System
Special Speed Video
Infrared Camera

### Advance Science & AI Research

Self-drive car
Genetic research
Advance Science Research

### High Performance Computing

Network Security Accelerator
Smart Network Accelerator
Network Storage Accelerator

### Finance

High-frequency Trading (HFT)
High-speed Trading (HST)
Accelerated Algorithmic Trading (AAT)
ATM

### Manufacturing & Equipment

Banknote recognition system
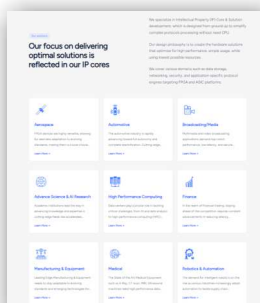Industrial Printer
Wireless Communication system

### Medical

High resolution CT scanner
X-ray inspection equipment

### Test & Measurement

4K/8K Display tester
Measuring instrument Storage option
Fishfinder System
Telemetry Device
Flow cytometer

**DG IP core Solution for Vertical Market
Appliaction Examples & Success histories**

https://www.dgway.com/market/

Please Contact us!

# Design Gateway Co.,Ltd.

Design Gateway is the expert in Intellectual Property (IP) Cores on FPGA,
with more than 35 years experience in FPGA logic design and development.
We can provide total solution with rich IP core portfolio
based on Intel FPGA devices.

URL        : https://design-gateway.com
E-mail     : ip-sales@design-gateway.com