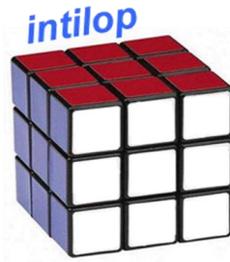


## 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board



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### **Ultra-High Performance System Solution**

**Fully integrated 1G bit**  
**PHY+MAC+TOE+PCIe+DMA+Host\_IF**

**On Select High End FPGA boards**

*SB 1G TOE-NIC (Ultra-Low Latency STOE+PCIe-Board)*

### **Top Level Product Specifications**

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## 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board

### *Most Reliable, Easiest and Fastest Time to Market cycle*

System board with Fully Integrated Complex Mega-IP Cores, ported and network tested, running on Xilinx/Altera FPGAs. System provides ultra-high performance NIC functionality. Intilop employs best of the breed FPGA design, simulation and implementation tools and practices to accomplish this feat.

*Board incorporates Fourth Generation TOE with ‘Ultra-Low Latency’ and Ultra-High Performance with highest TCP bandwidth in Full Duplex. Network Tested and mature TCP protocol offload implementation.*

### Board Key Features:

- Fully Integrated and Network tested System Solution running on Select Altera/Xilinx FPGA boards, providing; STOE+MAC+PHY+PCIe+DMA+Host\_I/F SoC IP bundle.
- Fastest integration cycle and time to market; Just drop in your logic.
- Ultra-Low Latency through 1G TOE = less than 250 ns
- Ultra-High Throughput: Receives and Sends sustained large TCP payloads, depending upon remote server/client’s capability.
- Benchmark Latency and Performance results for the full system available upon request.

### Time to Market with minimal Risk:

**SB 1G TOE-NIC** is the only board that integrates a Full 1G TCP Offload Engine, Ethernet MAC, PHY-Layers, Host\_CPU\_I/F on Select Xilinx/Altera FPGA boards so customers can easily deploy their own differentiated design on an ultra-high performance FPGA board running their application. This allows them to save months of valuable engineering time and resources in porting complex set of IPs to a FPGA platform, instead they can simply concentrate on their own design for ultra-fast system implementation and time to market with minimum risk.

### Complete Customizability & Scalability:

Intilop offers a wide range of Systems with Pre-integrated 1G and 10G TOE/UOE hardware cores for various end user applications. They include systems with Mutiple MAC+TOE, PCIe –Gen 2 or Gen 1 in x1/4/8 configurations, QDRx interfaces, DDRx interfaces and more. The standard System board features PCIe/DMA software driver and API that allows easy integration with customer’s applications running in Linux/host environment. This can also save them months of development time allowing them to concentrate on their own software application development.

## 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board

***SB 1G TOE-NIC*** is the only board that implements a full 1G bit PHY+MAC+TCP Full Offload Stack in Handcrafted, Ultra-Low latency and High Performance, flexible and scalable architecture which can also be easily customized for end product differentiation.

***SB 1G TOE-NIC*** is flexible and customizable for layer-3, layer 4-7 network infrastructure and network security systems applications. It is recommended for use in, among others, high performance Cloud Servers, Web Servers, Application servers, NICs, SAN/NAS, Network Security Appliances and data center equipment design applications. System contains Pre integrated and tested key IP building blocks for easy customer logic integration and deployment.

### Ultimate Performance Boost for your Network Bandwidth & ROI:

***SB 1G TOE-NIC*** can process TCP/IP sessions as client/server in mixed session mode for Network equipment and in-line network security appliances, simultaneously, at 1G-bit line rate. This relieves the host CPU from costly TCP/IP software related session setup/tear down, data copying and maintenance tasks thereby delivering 10x to 20x TCP/IP network performance improvement when compared with TCP/IP software.

The 1G Bit TOE is based upon the proven and mature patent pending TOE architecture from Intilop corporation.

The same architecture is scalable to 40 G bit.

### System design versions-

- **Generic TOE for Network infrastructure design applications:**

- 16 Session with Payload FIFO of 8/16/32 K bytes
- 32 Session with Payload FIFO of 8/16/32 K bytes
- 64 Session with scalable Payload FIFO of 8/16/32 K bytes.
- 128 Session with scalable Payload FIFO of 8/16/32 K bytes
- 128+ Sessions depend upon on-chip BRAM
- Very high performance DMA blocks also available to integrate with high performance PCIe Gen-2 x 8 interface.
- PCIe/Driver for Linux.

- **TOE with enhanced Security features (available upon request)**

- All of the options available in Generic TOE plus;
  - Protocol filter block can selectively direct traffic for any known application level protocol to any selected MAC port; e.g. all IM/chat traffic, SMTP (email), Web(http) traffic, VoIP etc. can be filtered and directed to selected ports.
  - IP and Port number filter block

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- iii. Specific IP and Port Filtered traffic routed to optional selected MAC interface/s or PCIe interface or Memory interface directly at line rate without CPU involvement.
- iv. MAC Filter block, traffic routed to any of the selected interfaces

### Benefits of Intilop TOE:

Featuring APIs at different levels the General TOE allows the application developer to easily migrate from software, to TOE hardware, to custom hardware, to achieve higher performance.

### Latency:

Board Latency Comparisons	Traditional NICs running TCP Software	Intilop H/W Acceleration
Wire to User_FIFO	20 – 30 us (in NICs with TOE)	600 – 800 ns (incl PHY+MAC+TOE)
Wire to Host Memory	40 – 50 us	2 – 10 us (Host+driver dependent)

- 2G bit Ethernet Throughput.
- Scalable solution; 40G

### APIs

Network applications use the Socket API. Typically OS implements the Socket API with a TCP/IP software stack. However, the Intilop TOE implements a standard Hardware API that bypasses the Kernel, places the user\_payload data directly in user\_space allowing next higher level applications to fully take advantage of TOEs full hardware Offload.

- Hardware API: Enables dedicated processing in the FPGA for application specific acceleration
  - Ideal for Very high performance specialized, differentiable ASICs or FPGAs for Network security or Network infrastructure applications
  - Fully verified using comprehensive verification methodology for ASIC ports and Network system tested core.
  - Smallest logic foot print; less than 30,000 Xilinx slices, Altera ALMs or 250,000 ASIC gates + on-chip memory
  - Fully integrated 1G bit high performance Ethernet MAC. IEEE 802.3z compliant.
  - Scalable MAC Rx FIFOs and Tx FIFOs make it ideal for optimizing system performance.
  - Hardware implementation of TCP/IP stacks' control plane and data plane.
  - Hardware implementation of ARP protocol processing.

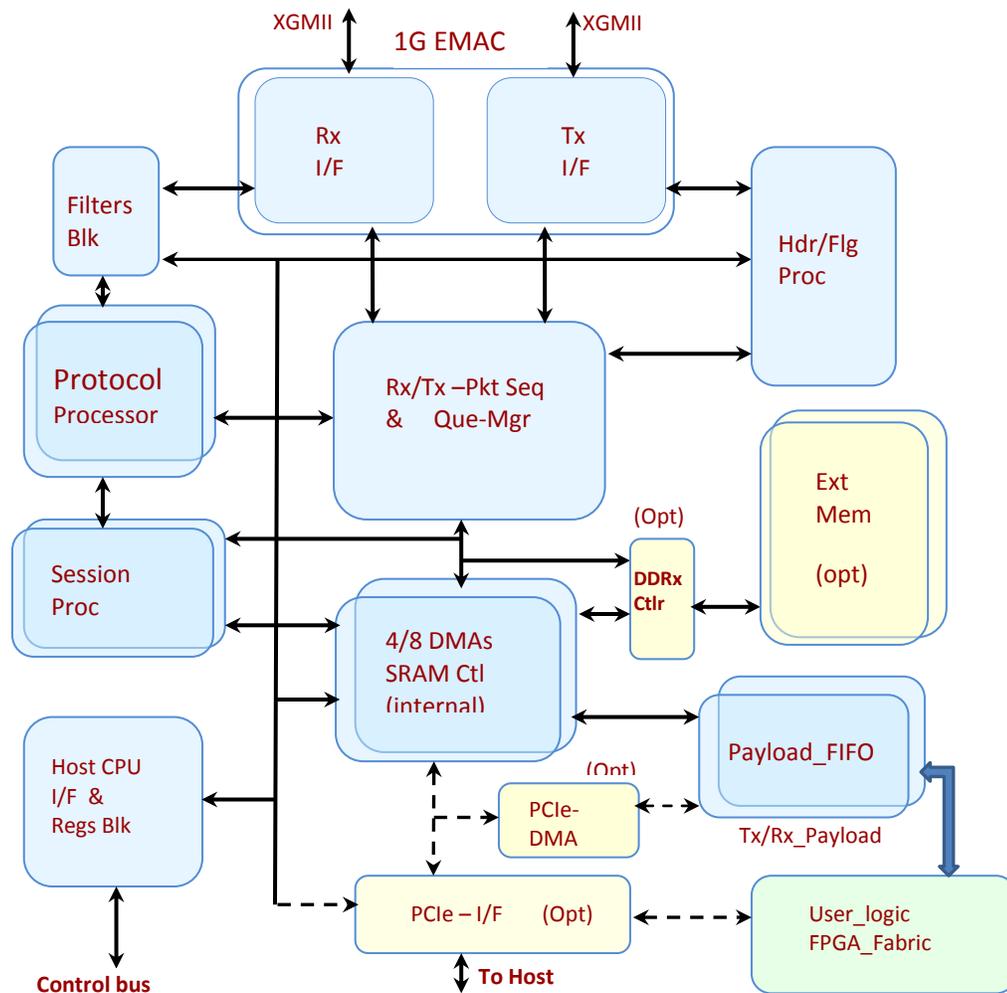
## 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board

- Extended ARP table creation, deletion management (optional)
  - Adheres to RFCs; 793, 1500, 1700, 813, 791, 2001
  - Hardware implementation of ICMP or Ping processing.
  - ‘Sliding Window’. Similar mechanism implemented in hardware allowing Flow Control
  - ‘Slow start’ transfer control in hardware (opt)
  - Customizable for IP-protocol only.
  - Non-TCP Bypass mode lets all Non TCP/IP related traffic go directly to host interface via User\_FIFO for TCP/IP software to handle
  - Can be deployed behind a gateway which will respond to Gateway-IP request as opposed to ARP request
  - On-chip DDR or SSRAM memory controller which can address from 4K Bytes to 4 MB Bytes on chip or 256 MB off chip memories (optional)
  - Simple User Side interface for easy hardware integration or a little more complicated for more power full and controlled ‘Streaming’ data transfers.
  - Many trade-offs for some functions performed in hardware or software
  - Configurable Packet buffers, session table buffers On-chip or Off-chip memories, attached DDR I/II interface. Depending on system, performance, ASIC/FPGA size
- requirements-> **User Customizable, (optional)**
- Interfaces directly to GMII, 1 G Bit serial interfaces. SGMII (opt)
  - Customizable to handle jumbo frames
  - Integrated PLB interface (Xilinx) or Altera PLB. AXI bus interface available
  - Integrated AMBA 2.0 interface or MIPs CPU bus for Local Processor control. (opt)
  - User programmable/prioritize-able interrupts
  - Performs connection/session management
  - Monitors, Stores, Maintains and processes up to 1024 live TCP sessions. Customizable to implement more, depending upon on-chip memory availability and other FPGA limitations.
  - Extendable to 4K TCP sessions. Internal Memory dependent.
  - Wire-speed 20-Gbps Ethernet and TCP performance in full duplex
  - Multiple TOEs can process up to 4K connections per second
  - TCP + IP check sum generation and check performed in hardware in less than 6 clks (30 ns at 200 MHz) vs 1-2 us by typical software TCP-stack
  - Connection Set up, tear down/termination and TCP data transfer without CPU involvement.

## 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board

- User programmable Session table parameters
- Dedicated set of hardware Timers for each TCP/IP session (opt) or customizable for sharing one set of common timers for all stale sessions.
- Multiple ‘slot storage’ for fragmented packets. More slots allocated when more On-chip Memory available. Self-checking available memory logic. (optional)
- Out of sequence packet detection/storage and Reassembly/Segmentation (optional)
- Direct Data placement in Applications buffer at full wire speed without CPU-> reduces CPU’s buffer copy time and utilization by 95%
- Support VLAN mode (optional)
- Easily customizable for filtering various IP and TCP traffic Protocols, directed towards any port or IP (Ideal for security appliances)
- Implements Full TCP/IP Offload. No CPU involvement at any TCP stage
- Future Proof- Flexible implementation of TCP Offload
- Fully integrated and FPGA ported PHY+MAC+TOE+PCIe/DMA System (opt)
- Basic mini API available for easy integration with Linux/windows. Others OSs/CPUs also available
- Fully integrate System with PCIe/DMA and driver (optional)
- EMAC+TOE+Host\_Interface as one bundle SoC.
- Standard Simple Streaming Data interface at Rx/Tx User\_FIFOs
- Future TCP Specs updates easily adaptable

# 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board



**1G TCP Offload Engine + EMAC (Simplified Block Diagram)**

Standard TOE

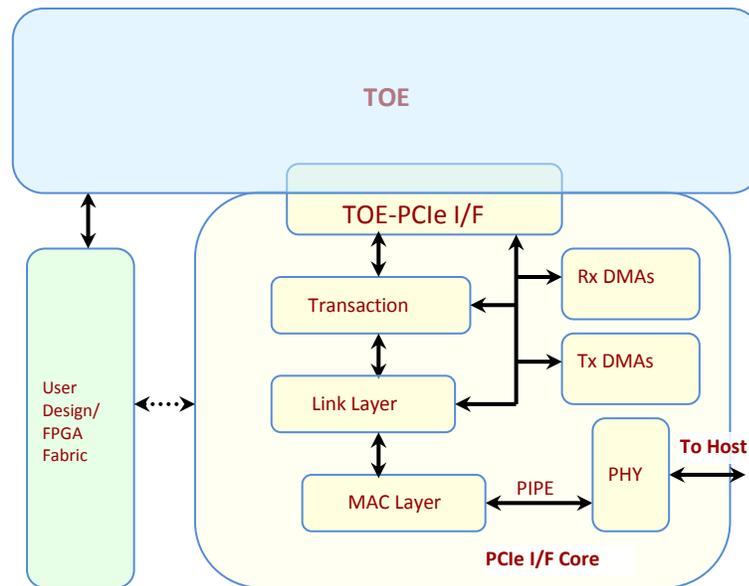
TOE Options

User Design

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## PCI Express IP core and TOE+PCIe FPGA NIC Key features:

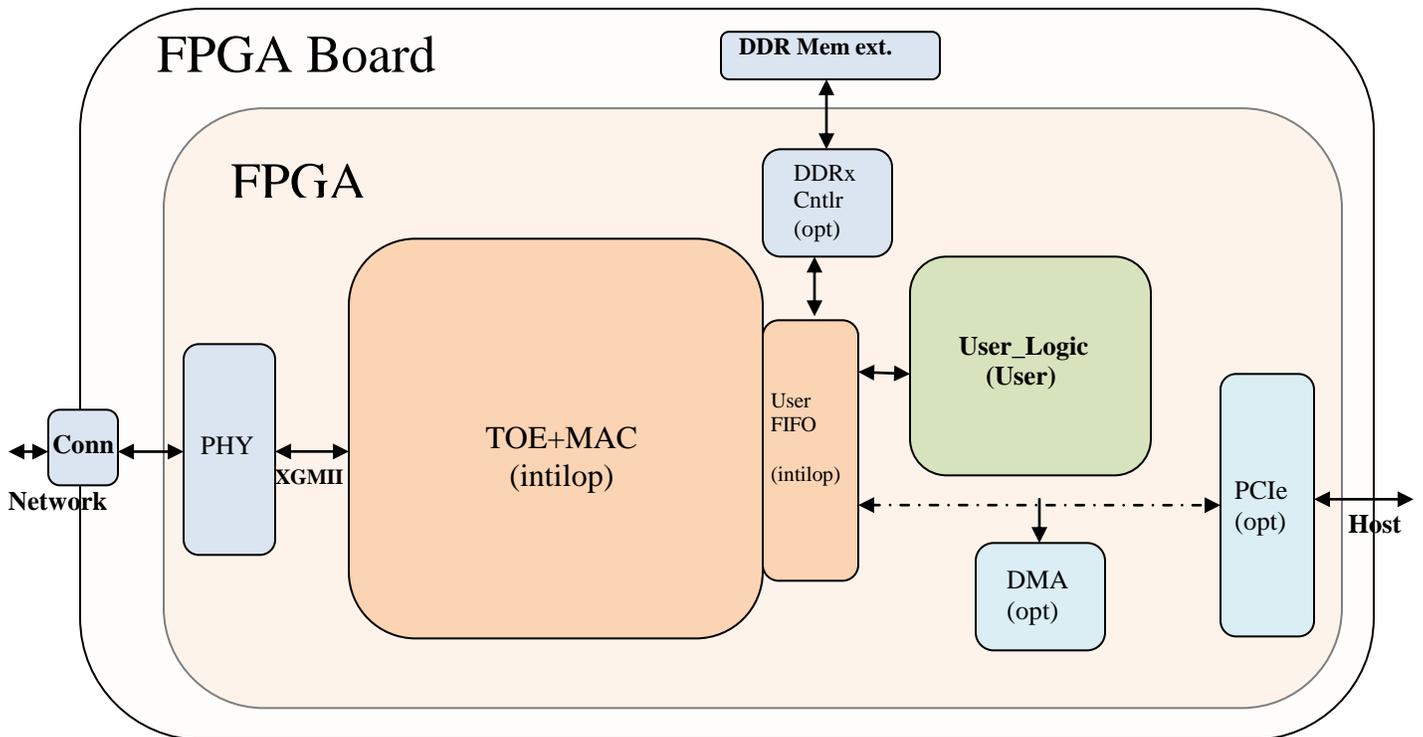
- Compliant with the PCI Express® Base Specification, revision 2.0 and 1.1
- Supports Native and Legacy Endpoint: x1, x4, x8 lanes
  - 1 Virtual Channel (VC) with standard TOE+DMA+PCIe NIC System
  - Up to 32 PCIe Virtual Channels available as Option
- Direct TOE Register access via PCIe interface.
- Dedicated and independent high performance TCP Payload Data Path between TOE and PCIe
- TOE-PCIe driver API for easy Linux Host System Application integration
- Standard TOE+PCIe+DMA FPGA-NIC implements up to 4 DMAs.
- Includes Physical, Data Link, Transaction, and EZDMA Application layers
  - Optimized for high throughput and minimal latency
- PIPE interface to PHY
  - 16-bit/125Mhz or 8-bit/250Mhz
- Maximum payload size up to 2KB
- Number of outstanding read requests: up to 16
- Up to 6 BARs plus expansion ROM
- DMA-based user's interface
  - Up to 8 DMA channel option
  - Scatter-Gather support with host based descriptors
  - Integrated DMA arbitration optimized for maximum throughput
  - PCIe Standard Linux Driver with fully Integrated FPGA-NIC-System/development Kit
- Ultra-High Performance, Ultra-low latency PCIe driver with fully Integrated FPGA-NIC-System/development Kit, available as Option



**TOE + DMA + PCIe (Simplified Diagram)**

Standard TOE      TOE Options      User Design

## 1 G Bit TCP Offload Engine (TOE-NIC) - S-Series- Fully Integrated FPGA board



**FPGA Board System with fully integrated and tested;  
PHY+MAC+TOE+PCIE+DMA+Host\_IF, available on select boards from intilop  
board partners**

**Contact: [info@intilop.com](mailto:info@intilop.com) for more details**

***Board and FPGA Specifications available at:***

FPGA Vendors: [www.Altera.com](http://www.Altera.com)

[www.Xilinx.com](http://www.Xilinx.com)

Board Vendors: [www.bittware.com](http://www.bittware.com)

[www.hitechglobal.com](http://www.hitechglobal.com)

[www.Nallatech.com](http://www.Nallatech.com)

[www.plda.com](http://www.plda.com)

[www.terasic.com](http://www.terasic.com)

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### **Deliverables:**

- FPGA board/Project files.
- IP NetList.
- System Networking test software.
- Test Bench, ,vcd files, configuration code/API for easy Linux port
- Verilog models for various components e.g. TCP/IP Client and Server models, transaction model (optional)
- External memory interface/model (optional).
- TCP Model (optional)
- Verification suite (optional)
- Test packet-traffic suite (optional)

***CONTACT: [info@intilop.com](mailto:info@intilop.com) for latest system Specifications***

### **Full FPGA Solutions License Purchasing Options:**

- **Fully Integrated/Ported IP cores and Network tested FPGA development System Platform with specified interface options**
- **IP Customization and Customer Hardware and or Application Software integration services.**

**Contact [sales@intilop.com](mailto:sales@intilop.com) for details**

