

FPGA-Based Solutions for Storage-Area Networks

Xilinx FPGAs provide a solid foundation for value-add software.

by Sriram R. Chelluri
Marketing Manager
Xilinx, Inc.
sriram.chelluri@xilinx.com

Bryce Mackin
Manager, Vertical Marketing Storage & Servers
Xilinx, Inc.
bryce.mackin@xilinx.com

David Gamba
Senior Marketing Manager,
Vertical Marketing & Partnerships
Xilinx, Inc.
david.gamba@xilinx.com

FPGAs have played a critical role in the development of emerging technologies for SAN infrastructure products such as hubs, switches, RAID arrays, and storage appliances. In these products, FPGAs have been used in data compression, encryption, protocol translation, RAID striping, and virtualization.

In today's SAN market, a company's main value-add is in the software. Most emerging and established companies turn to software instead of hardware to give them cost and feature advantages. FPGAs allow companies to keep their intellectual value-add in software and still offer the hardware benefits of increased performance and scalability to meet requirements for current data-center products. An FPGA-based design allows you to create value-add in software that enables using license keys for adding product features and functionality – without having to rip and replace products to support additional functionality.

Other benefits of FPGA-based product designs are reduced time to market, field upgradability to support enhanced protocols, and configurable scalability to meet various protocol and performance requirements often encountered by product manufacturers. FPGAs also offer a lower total cost of development (TCD) in the long

meeting the performance and scalability requirements of applications has become a challenge – and no vendor wants to be the performance bottleneck in a storage infrastructure. Therefore, product designers use FPGAs as the “glue” chip in interconnecting encryption ASICs that provide standard algorithms and key management

can be at the file level (as in a network attached storage [NAS] box) or at the block level (as in IBM’s SAN Volume Controller [SVC]). These classes of devices provide storage services such as management of available disks, data mirroring, and replication.

To achieve performance and scalability requirements, vendors often use FPGAs to

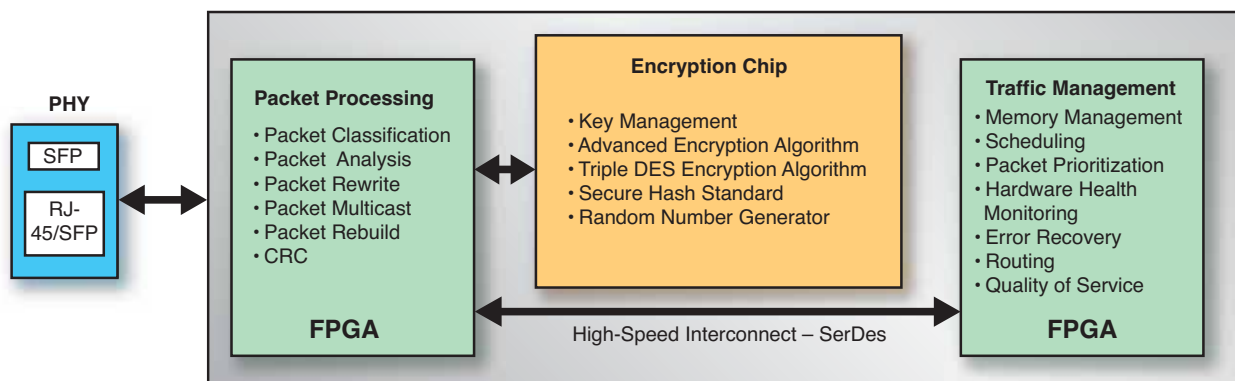


Figure 1 – FPGA-based security appliance

term, providing a flexible design option as product requirements change to meet business requirements. Compared to ASIC- or CPU-based designs that might be “too little too late,” FPGAs allow you to add functionality to meet ever-changing market demands.

User demand for features and functionality in storage products has outpaced any CPU- or ASIC-based solutions that are bound by performance and scalability limitations. In this article, we’ll explore some design solutions based on Xilinx® FPGAs for a subset of SAN ecosystem products found in typical data centers, such as security appliances, storage virtualization devices, and multi-protocol switches.

Data Security Solutions

Securing data in transit from the fabric to the disk is of critical importance for enterprise IT managers. System designers are coming up with new products for securing data at the server level, at the core of the fabric (like a switch), at storage/tape devices, or as an appliance that can be placed in the data path and integrated into the current infrastructure.

Keeping enterprise data secure and

functionality for performing the wire-speed packet inspection and processing required for application up-time.

Figure 1 shows how a security appliance can use a combination of FPGAs and off-the-shelf standard algorithm encryption chips to protect data at wire speed. Additional value-add features such as custom encryption, threat monitoring, and virus checking can be added in the FPGAs and enabled as licensed features without having to rip and replace product designs to enable these new features.

Storage Virtualization

Fibre Channel switching architectures allowed companies to scale servers and storage independently. Server and storage virtualization is the next evolution of the data center. A number of vendors offer server virtualization based on the high-speed InfiniBand protocol. Server virtualization allows IT administrators to allocate compute time to applications based on available resources.

Similarly, by virtualizing storage in a data center, system administrators can allocate storage based on performance, cost, and application policies. Storage virtualization

provide the necessary hardware acceleration and meet the latency requirements of the SCSI/iSCSI protocol. Some of the FPGA-based hardware assistance functions implemented in storage virtualization products are:

- TCP offload
- Packet classification
- Ethernet: TCP or UDP
- Fibre Channel
- InfiniBand
- Traffic manager for queuing and scheduling
- Cyclic redundancy check (CRC) processing
- Protocol rate matching
- High-speed interconnect

Figure 2 shows how FPGAs fit into the design of a storage virtualization product.

FPGAs are primarily considered to be the glue chip in product design, providing hardware assistance for compute- or I/O-intensive applications. Additional functionalities such as packet classification and TCP offload can be added to FPGAs that have powerfully built CPU cores.

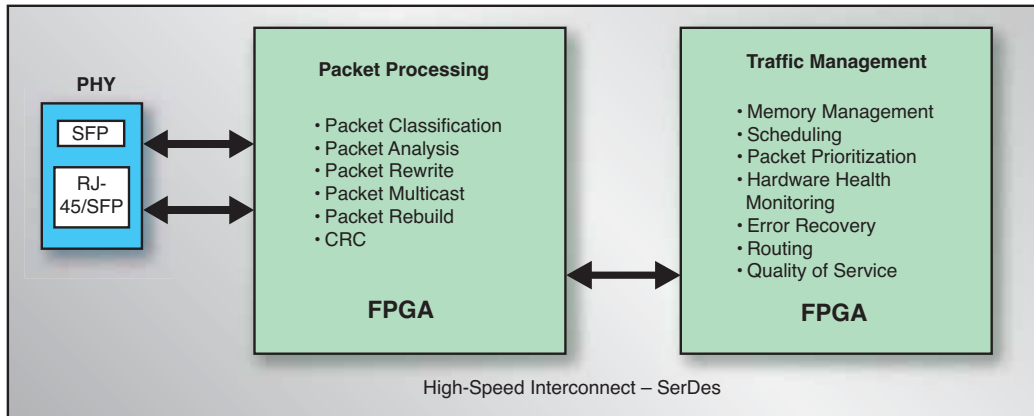


Figure 2 – FPGA-based storage virtualization product

Besides OSI layer 2-5 functionality, features that provide a competitive edge – encryption, mirroring and replication, fast lookup algorithms, XML processing, and anti-virus scanning – can all be built into the product and enabled by software license keys, without having to build ASICs or undertake complicated board designs.

Benefits

As costs continuously decrease for raw disk storage, vendors are looking to software services to provide value-add features such as volume management, mirroring, and replication services. To meet the performance and scalability requirements and yet keep costs down, you can use FPGAs to provide an opportunity to maintain margins in software without having to develop ASICs or add additional CPUs to meet application requirements.

Multi-Protocol Switch

Over the years, Ethernet and Fibre Channel switches have increased in port density, performance, and scalability. Enterprise customers are looking to multi-protocol switches to provide Ethernet,

Fibre Channel, and gateway functionality. Some vendors already ship multi-protocol switches with dedicated or selectable Fibre Channel and Ethernet ports for SANs. As the media interconnect, link speeds, and protocol functionality become common across protocols, FPGAs with CPU cores can accommodate flexible design. Figure 3 shows how modern FPGAs can be used to support a variety of functions, including:

- Multi-protocol packet processing
- Protocol conversion
- Multicast and broadcast
- Routing
- Block and file search
- Buffer management

Conclusion

Established companies and venture-funded startups see software services for enterprise SAN products as the key enabler to valuations and margins. Solutions that require deep data inspection, such as security and storage appliances, firewalls, XML processors, and web-load balancers are an ideal choice for FPGAs or FPGA-based co-processing solutions.

In order to “beat the cost” out of the product, systems-level designers are looking to FPGAs instead of ASICs or general CPUs as the enabling technology to help them meet performance and scalability requirements, while at the same time keeping TCD within budget.

For additional information, visit www.xilinx.com/products/silicon_solutions/fpgas/easypath/index.htm.

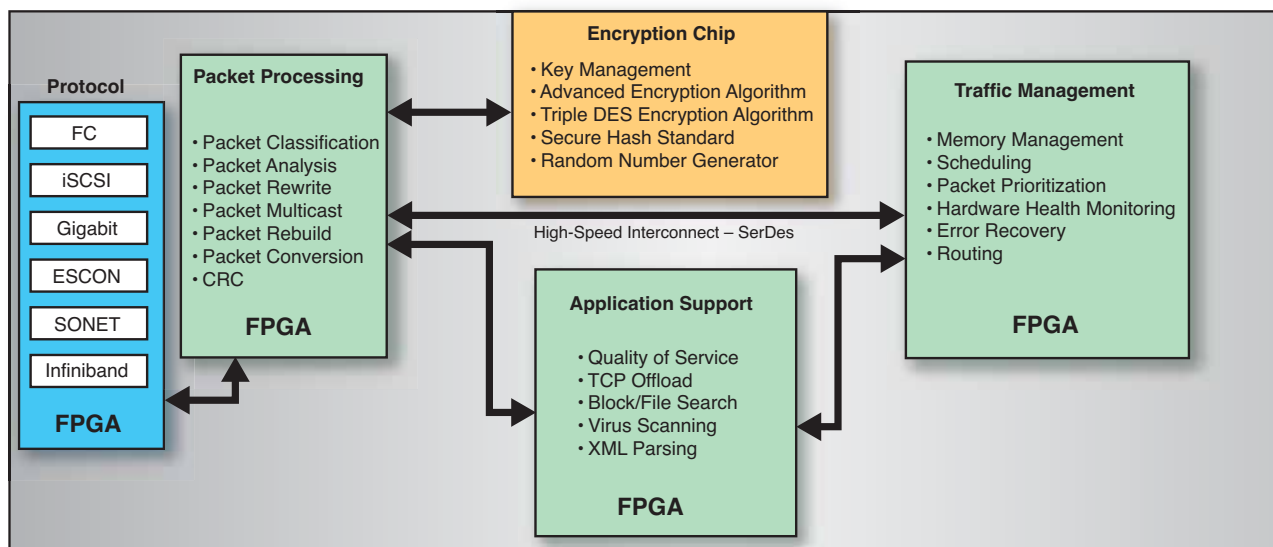


Figure 3 – FPGA-based multi-protocol switches