Co-Processing Solutions for Delivering Storage Services Over Distance

Virtex FPGAs enable a services-based architecture for delivering secure file solutions over distance.

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Initially, storage area networks (SANs) have enabled enterprises to consolidate servers and storage, centralized backups, and implement a tiered storage model for data replication and disaster recovery within the data center. SANs are evolving into service area networks, providing geographically dispersed remote file and database access, mirroring and replication for disaster recovery, and truly centralized backups.

Consolidating resources has reduced hardware costs and simplified the purchasing and management of data centers. However, similar gains have not been made in branch and remote offices. Traditionally, these offices have a mini-IT infrastructure similar to the corporate office, comprising:

- File/print services
- Backup (local and remote)
- Wide area network (WAN) access

Having branch offices completely depend on remote access to the corporate data center does not provide the performance requirements necessary to conduct business on a daily basis. High-speed WAN links are costly, prone to reliability issues, and have a high latency that storage protocols such as SCSI cannot tolerate. Many startups and established companies are developing products to fix these issues and bring the same level of services like mirroring, replication, and backup that SANs have enabled in the data center to remote offices.

In this article, I'll cover solutions that can be enabled by reconfigurable programmable logic in service area networks, highlighting file services for remote offices often referred to as wide area data services/wide area file services (WADS/WAFS). As an example, I'll describe how you can implement data security as a co-processing solution in an x86-based appliance.

Wide Area Data Services/ Wide Area File Services

WADS/WAFS is a fairly new concept in providing IT services to branch and remote offices. The goal is to provide LAN-level performance with scalable and redundant storage services from a centralized corporate data center to remote offices, as shown in Figure 1. WADS/WAFS technology essentially enables IT administrators to provide consolidated services to remote sites. In this article, I will use the terms wide area data services and wide area file services interchangeably, because as the products mature, the distinction between the two will disappear.

Storage services appliance products enable branch/remote offices to gain Tier-1 IT services without building an entire infrastructure. WAFS are a subset of these data services and provide a range of functions, including:

- File and print services
- E-mail services
- Web services
- Network services
- RAID services

Currently, most of the services are provided in some kind of appliance running Windows or Linux file and print services supporting common Internet file systems (CIFS) or network file systems (NFS). The hardware is essentially a dual/quad Intel Xeon processor, a large RAM or hard disk to keep track of files, and high-performance gigabit network interface cards for connectivity. What separates each vendor are the software features running on these appliances: file performance, WAN optimization, quality of service, security, application support, and management features.

Remote storage services based on general-purpose architectures are not optimized for data-networking functions. Instead of throwing raw CPU power at performance and scalability problems in wide area data services, an alternative approach would be to run storage and networking services on a Xilinx® Virtex™ FPGA co-processor. Xilinx FPGAs provide high performance and scalable software-enabled services without having to over-design the hardware for future-proofing. Some of the services that can be implemented in the FPGAs are:

- File services: distributed lock manager, hashing tables, file caching, access control
- Network services: TCP offload (1G/10G), compression, web caching, link management
- Security services: encryption, anti-virus checking, intrusion detection
- Protocol support: protocol conversion (GE, FC, iSCSI, FCIP), packet multicast/broadcast, link management, routing
- System management: link statistics, file statistics, service-level agreement (SLA) monitoring

Figure 2 shows the functionality that can be implemented as a co-processing solution on one or more FPGAs, depending on the chipset. Software services can be phased into the WAFS products from a central location, fine-tuning services to branch offices based on policy-based business needs. Besides core file and network level optimization, a co-processing solution can also increase performance of protocols such as CIFS and NFS. Also, programmable logic enables services like data and network security, data classification, and mining at wire-speed for applications like

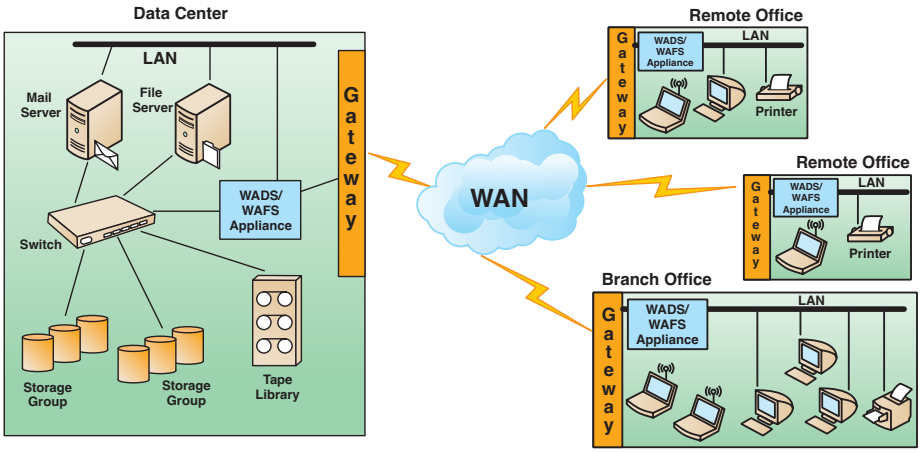

Figure 1 – Corporate IT infrastructure

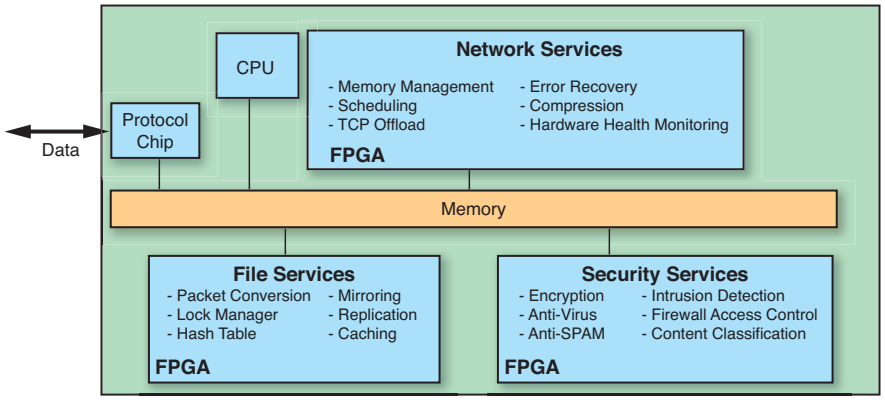

Figure 2 – Data and networking services on a Virtex-4 FPGA

Microsoft Exchange, Autodesk AutoCAD, Oracle DB, and Veritas NetBackup.

The following example shows a standard architecture that you can use to implement data security either on a motherboard (Figure 3) or as a plug-in PCI interface card (Figure 4).

Implementing Data Security

A Virtex FPGA-based co-processing solution for data security enables x86-based appliances to scale the performance bottlenecks encountered in a pure software approach. A typical x86 appliance for a mid-range to enterprise data center server comprises:

- Dual or quad CPUs
- High-speed bus (PCI Express/HyperTransport)
- More than 1 GB RAM
- Integrated GE NICs
- Internal storage

Even though these are high-performance general processors, performing encryption services will consume lots of CPU cycles for encrypting and decrypting packets, leaving little processing time for other services. By downsizing the CPU and other hardware requirements and adding a Virtex FPGA as a hybrid solution, you can optimize the hardware to perform the following functions:

Generic CPU:

- Load and run OS
- Manage peripherals
- Manage connectivity (GE/FC/iSCSI)
- Run applications (e-mail/database)
- Dataflow control
- Key management

Virtex Co-Processor:

- High-performance encryption and decryption
- High-performance compression and decompression
- High-performance protocol conversion

You can implement services such as encryption, compression, and protocol conversion in a small Virtex-4 device, with leftover slices for additional services. By implementing core services in programmable hardware logic, you can take advantage of performance gains and reprogram the hardware to add and modify hardware-assisted services as business requirements change.

Conclusion

Software services provide a competitive advantage by delivering storage services over a wide area. Xilinx Virtex-II Pro or Virtex-4 FPGA-based co-processing solutions provide a flexible and scalable high-performance architecture for delivering secure file-level solutions to branch and remote offices.

By offering proven Ethernet and Fibre Channel IP cores, as well as third-party encryption, compression, and network security solutions, Xilinx and its partners allow developers with flexible multi-protocol IP cores to reduce time-to-market delays and high NRE costs associated with ASIC-based solutions.

For more information and technical details on Xilinx and third-party IP cores for storage services co-processing solutions, visit *www.xilinx.com/storage*, or e-mail *storage@xilinx.com*.

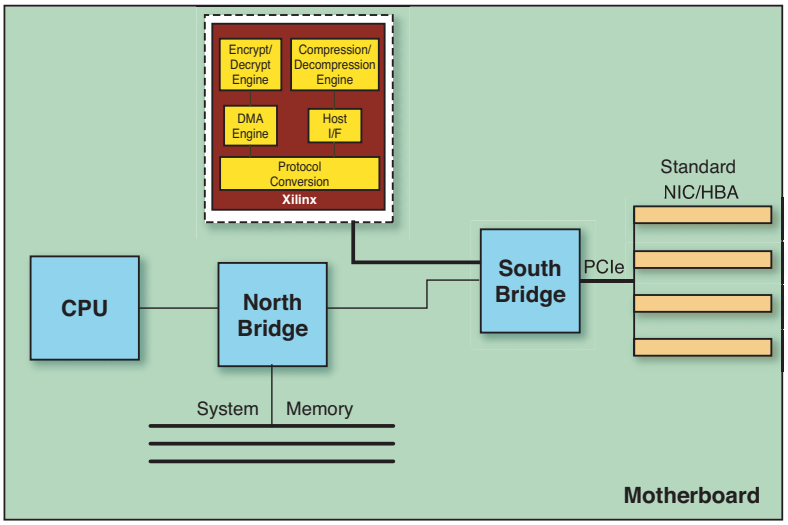

Figure 3 – Built-in co-processor on a motherboard

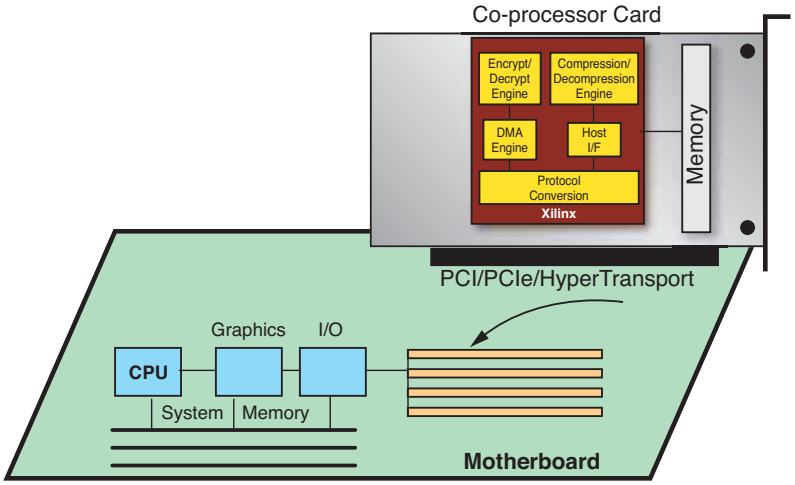

Figure 4 – Plug-in module for motherboard