Accton
Making Partnership Work

Intel® DPDK Boosts Server Appliance Performance

White Paper

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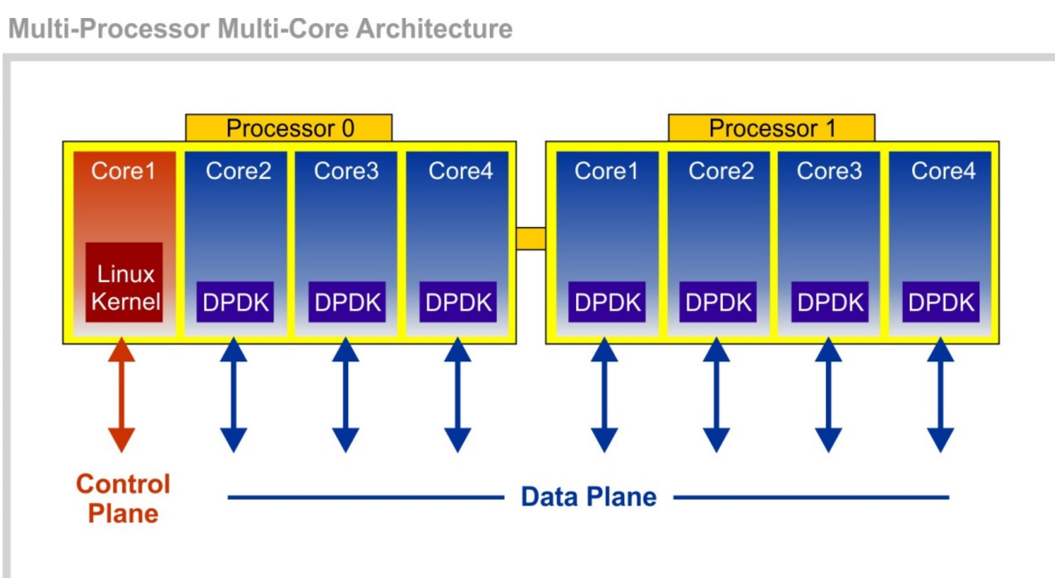
Introduction

As network speeds increase to 40G and above, both in the enterprise and data center, the bottlenecks within critical network devices has become a more pressing problem. Essentially, devices have to move network packets from ingress LAN ports to system memory and then to egress ports as fast as possible. This fundamental “data plane” packet processing determines the basic throughput on any device platform. To help alleviate the data plane bottleneck, Intel® developed the Data Plane Development Kit (DPDK) for software applications that run on standard Intel® x86 CPU hardware platforms.

This paper examines the main building blocks of Intel’s DPDK and how it significantly boosts data plane throughput on Intel® x86-based hardware. In particular, how the DPDK reduces overheads in a standard Linux operating system environment, the preferred developers choice for application software that runs on open-platform appliances. Additionally, how the tremendous DPDK performance enhancement enables the deployment of consolidated open-platform server appliances for next-generation networks.

Inside Intel®’s DPDK

Intel®’s DPDK is basically a set of software development libraries that can be used to build high-performance applications to run on Intel®-based network appliance platforms. The DPDK components leverage Intel® CPU multi-core and multi-processor architecture for optimized data-plane throughput.



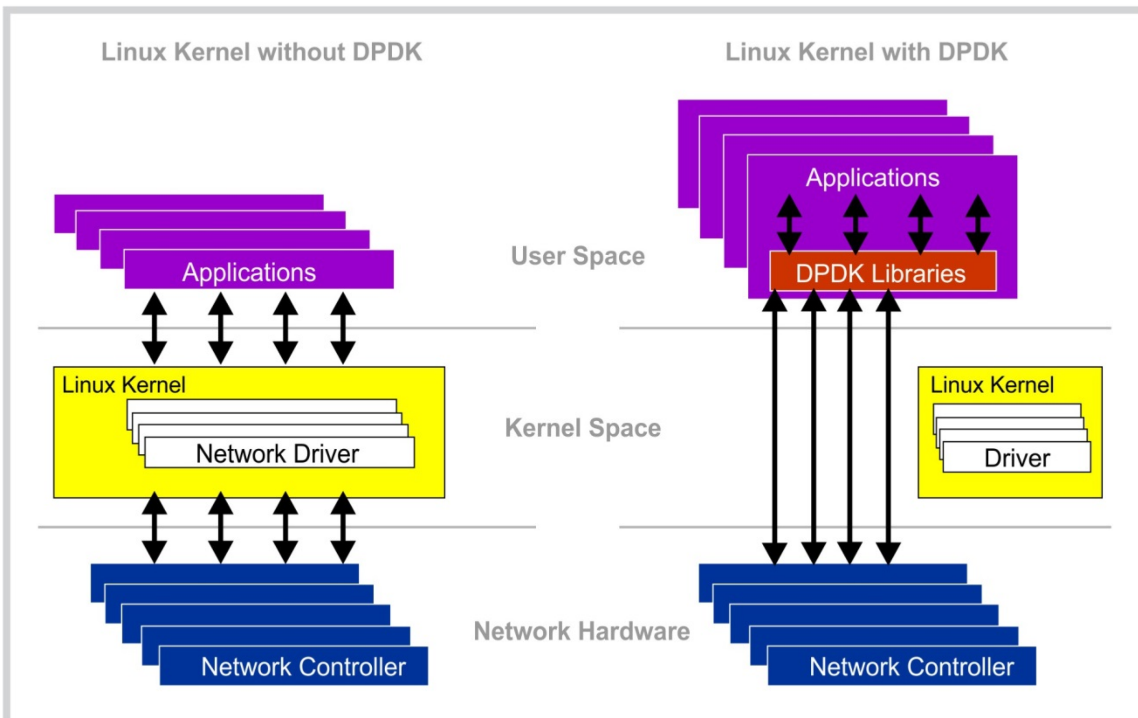
The main components of the Intel® DPDK libraries can be summarized as follows:

- **Memory Manager**: Allocates memory for pools of objects. Each pool implements a ring to store free objects and the manager ensures that objects are spread equally on all DRAM channels.
- **Buffer Manager**: Pre-allocates fixed-size buffers stored in memory pools. Saves significant amounts of time that an operating system uses to allocate and de-allocate buffers.

- **Queue Manager**: Avoids unnecessary wait times by providing fixed-size lockless queues for software components to process packets.
- **Flow Classification**: Implements an efficient mechanism for placing packets in flows for fast processing to boost throughput.
- **Poll Mode Drivers**: These are drivers for 1 and 10 Gigabit Ethernet controllers that work without interrupt-based signaling to speed up the packet pipeline.

The Intel® DPDK libraries run on open-source Linux systems in the user space, just as any other Linux utilities. This means that when building software applications, the DPDK libraries allow direct access to the hardware without using the Linux kernel. The data plane processing is handled by the DPDK libraries that pass network packets directly to the application network stack without any Linux kernel overhead.

Linux Kernel with DPDK



Application Acceleration

Typical network infrastructure packet sizes are small (64 bytes), but arrive at network interfaces at a very high rate, placing a major stress on data plane processing. Server packet sizes are typically large (1024 bytes) and therefore only arrive at interfaces at slower rates. For Gigabit interfaces on a system using interrupt-driven network drivers, the number of interrupts for received packets rapidly overwhelms the system. Implementing DPDK applications that use polled-mode network drivers provides a significant throughput improvement.

The DPDK libraries enable software tasks to be bound to a specific CPU core. This one-to-one mapping of software threads to hardware threads completely avoids the problem of excessive overhead for the Linux scheduler to switch tasks.

When system access to memory or PCIe is slowing CPU operation, the DPDK libraries can release bandwidth by processing four packets at a time and reduce multiple memory reads to a single read. The DPDK libraries can also be used to streamline memory access by aligning data structures to cache sizes and minimizing access to external memory. This means data can be pre-fetched before it is needed and the CPU does not have to wait.

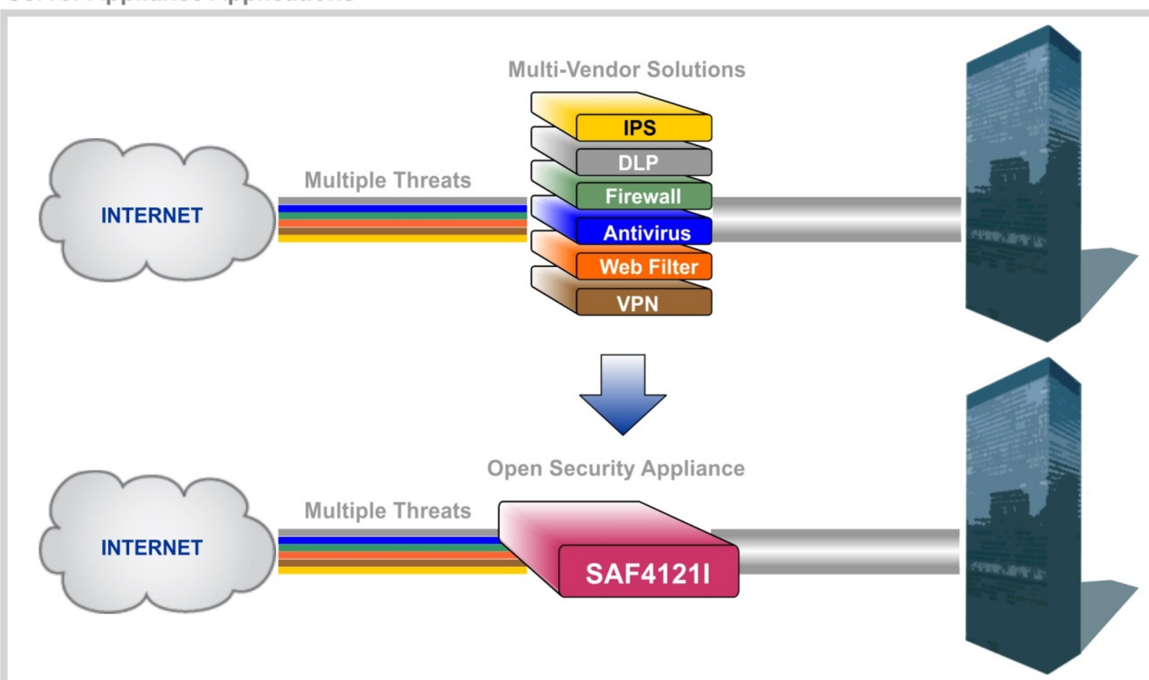
Often an application requires access to shared data structures, which can result in a serious bottleneck. With DPDK libraries, you can implement optimized schemes and lockless queues that reduce the amount of data sharing.

Altogether, Intel DPDK delivers a powerful software model for application development that dramatically increases small packet throughput by three to four times. In fact, systems based on Intel's high-end processors have achieved Layer 3 forwarding rates of over 80 million packets per second (Mpps) for 64-byte packets.

Benefits for Server Appliances

The impressive data plane throughput of Intel's DPDK on standard Intel architecture means it is perfectly suited for building a wide range of high-performing network appliances. Accton's open-platform server appliances support DPDK for leading-edge firewall, routing, VPN, or many other services. The flexible platforms are truly open and can scale in capacity to meet any number of data network functions.

Server Appliance Applications



Furthermore, Accton's open platforms offer a highly adaptable alternative to fixed-function devices. The high performance of DPDK enables a number of mixed-vendor devices to be consolidated into one open device that not only reduces complexity, but saves significant costs and resources.

Conclusion

The implementation of Intel®'s DPDK has set new standards for data plane throughput on standard Intel® x86 CPU hardware platforms. As Intel® CPU development surges forward, the dramatic improvements in packet processing performance will only increase, allowing more data workloads to be consolidated on one unified open device. This is an expected trend as enterprise and data center networks move towards agile systems based on open hardware and software.

Accton's server appliances, such as the SAF4121I, are designed as open high-performance platforms based on standard Intel® x86 communications hardware. These platforms enable any available operating system and software applications to be installed, creating customized flexible devices that are a solid future-proof investment for any next-generation network.

Accton SAF4121I Open Server Appliance

Sandy Bridge Gladden CPUs supported:
- Intel® Xeon® E3-1125C (4C8T, 8MB Cache, 2.00 GHz)
- Intel® Xeon® E3-1105C (4C8T, 6MB Cache, 1.00 GHz)
- Intel® Core™ i3-2115C (2C4T, 3MB Cache, 2.00 GHz)
- Intel® Pentium® B915C (2C4T, 3MB Cache, 1.50 GHz)
- Intel® Celeron® 725C (1C2T, 1.5MB Cache, 1.30 Ghz)

Ivy Bridge Gladden CPUs supported:
- Intel® Xeon® E3-1125C v2 (4C8T, 8M Cache, 2.50 GHz)
- Intel® Xeon® E3-1105C v2 (4C8T, 8M Cache, 1.80 GHz)
- Intel® Core™ i3-3115C (2C4T, 4M Cache, 2.50 GHz)
- Intel® Pentium® B925C (2C4T, 4M Cache, 2.00 GHz)

Intel® Communication Chipsets supported:
- Intel® DH8920 PCH (Crypto 20Gbps)
- Intel® DH8910 PCH (Crypto 10Gbps)
- Intel® DH8903 PCH (Crypto 3Gbps)
- Intel® DH8900 PCH (w/o Crypto)

Optional modules supported:
- 2-port 10 GbE SFP+
- 8-port GbE SFP
- 8-port GbE SFP
- 8-port GbE RJ-45 with 4 pairs LAN bypass
- 8-port GbE RJ-45
- 4-port GbE RJ-45 with 2 pairs LAN bypass
- 4-port GbE RJ-45

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