Solution Brief

Cloud Service Providers
Intel FPGAs

Accelerate Your Data Center with Intel® FPGAs

Infrastructure Processing Units (IPUs) based on the Intel® FPGA IPU C5000X platform help cloud service providers (CSPs) make the most of their network capabilities and help improve revenue from infrastructure investments.

As the cloud continues to augment on-premises data centers, providing quality services at a competitive price is becoming increasingly important in the crowded and competitive cloud service provider (CSP) industry. To keep customers happy, CSPs must offer low-cost, high-performance cloud services that often require an infrastructure built with the fastest processors, storage, and networking components.

Profits for CSPs are dependent on how much revenue can be realized per CPU, either through direct monetization of cloud computing services or through cloud-native applications delivered as a service. Increasing network speeds complicate this picture because traditional data center architectures require precious server CPU cores to handle networking overhead tasks. While some foundational network interface controllers (NICs) can offload a certain amount of packet processing from a server's CPU, more offloading capabilities are required to keep pace with growing network speeds, increasing local and disaggregated storage needs, and new security and management layers. Additionally, as network speeds move toward 100 gigabits-per-second (Gbps), overall data center performance can suffer as a result of relying on CPU cores alone for increasingly complex network functions.

IPUs based on the Intel FPGA IPU C5000X platform can help improve data center performance by offloading network functions from server CPUs, which can increase network throughput and lower latency. In addition, these IPUs can be customized to help increase data center automation and security by offloading network management and security functions from the server's CPU. By deploying IPUs based on the Intel FPGA IPU C5000X platform across the data center, CSPs can realize tangible performance gains while increasing per-CPU profits.

"FPGAs have been the core of Azure's SmartNIC infrastructure for multiple generations, providing us a high performance, flexible, and differentiated solution. We are pleased to see Intel continue to lead the industry by launching the ground-breaking Intel FPGA SmartNIC Platform C5000X that will enable cloud service providers to integrate FPGA technology in their data centers to increase their efficiency, while providing flexibility to suit their needs."

**— Derek Chiou,
Partner Architect, Microsoft**

Optimize server CPU utilization and performance with IPUs based on the Intel FPGA IPU C5000X platform

Foundational NICs, like those commonly found in today's data center architectures, are based on application-specific integrated circuits (ASICs). While these NICs have been used successfully for decades, their capabilities are relatively fixed and specific to traditional packet processing, which puts much of the networking and storage overhead burden of modern high-speed cloud data centers onto the server's CPU. The CPU cycles that could be used for revenue-generating tasks must be allocated to processing basic network and storage infrastructure overhead. As network speeds increase, additional CPUs are needed to keep up.

IPUs based on the Intel FPGA IPU C5000X platform are more programmable and flexible in that they offload and accelerate network overhead processing, storage, security functions such as encryption, and network management onto a dedicated FPGA and an Intel® Xeon® D processor.

By offloading these functions from server CPU cores, IPUs based on the Intel FPGA IPU C5000X platform can provide more infrastructure processing features and support higher network speeds while leaving CPU cores available for revenue-generating applications. Freeing up high-performance CPU cores also means that CSPs can more effectively manage their resources while offering more competitive service-level agreements (SLAs) to their customers.

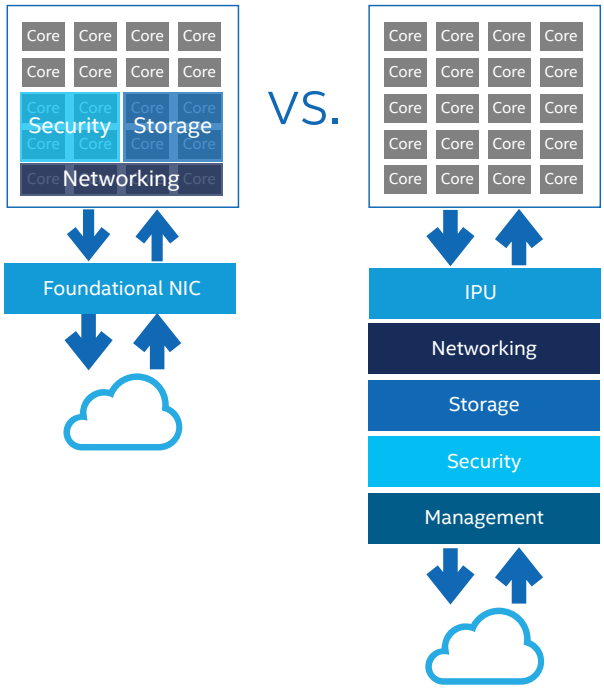

Figure 1. IPUs based on the Intel FPGA IPU C5000X platform can help increase data center performance through increased network throughput, lower latency, and better server CPU utilization

Extend IPU capabilities with customized software solutions

Part of the flexibility of IPUs based on the Intel FPGA IPU C5000X platform is that they can be deployed in an out-of-the-box configuration, much like a foundational NIC. But as cloud data center feature requirements and standards evolve, IPUs based on the Intel FPGA IPU C5000X platform can be reprogrammed to further customize packet processing, storage, security, and network-management capabilities. This is programmable hardware at the speed of software.

Network capabilities that are normally handled by server CPUs can be easily ported to the FPGA and Intel Xeon D processor by using Data Plane Development Kit (DPDK) and Storage Performance Development Kit (SPDK) drivers that are optimized for x86-based CPUs. These development kits contain software libraries and drivers that let software developers customize and offload packet-processing functionality to IPUs based on the Intel FPGA IPU C5000X platform. DPDK is designed to accelerate network packet processing functions, while SPDK is designed to optimize storage-traffic functions. Initially created by Intel, DPDK is now an open source project hosted by The Linux Foundation, while SPDK is an Intel project that is freely available.

> **"Inventec is proud to have partnered with Intel to create a unique SmartNIC based upon the Intel FPGA SmartNIC C5000X platform architecture. We immediately realized that this platform would stand out as the SmartNIC for the future, offering customers the ability to customize while still delivering the outstanding performance, programmability, and portfolio of technology that only Intel can provide."**
>
> **— George Lin, General Manager of Business Unit VI, Inventec Enterprise Business Group (Inventec EBG)**

An IPU's programmability means that CSPs can create, modify, or update network processing, storage, security, and management rules and protocols within a changing business environment. For example, if a CSP's business offerings expand to include faster networks and more network security options, additional servers would likely be required to handle the additional application throughput. With IPUs based on the Intel FPGA IPU C5000X platform, the expanded demands on infrastructure processing can be deployed to the IPU within an existing server environment. These IPUs can simultaneously unlock application performance gains by removing new bottlenecks that would otherwise have arisen. By reducing or eliminating infrastructure processing bottlenecks, IPUs based on the Intel FPGA IPU C5000X platform can help lower the total cost of ownership (TCO) and extend the lifespan of infrastructure investments due to changing business requirements, all while increasing revenue-generating server utilization.

IPUs based on the Intel FPGA IPU C5000X platform pair with the same ubiquitous x86 platforms commonly found in today's CSP data centers. Because IPUs based on the Intel FPGA IPU C5000X platform use x86-based Intel Xeon D processors, software developers are developing for the same x86-based CPUs they're already familiar with, making the software-porting effort minimal. This familiarity can also help reduce ramp-up time and development costs.

Optimize data center revenue and performance with IPUs based on the Intel FPGA IPU C5000X platform

As network speeds and processing complexity increase, IPUs based on the Intel FPGA IPU C5000X platform can help deliver high-performance network capabilities while increasing overall data center performance and revenue. As a flexible and extensible networking solution, these IPUs provide CSPs with the capabilities they need to be more competitive while giving software developers a familiar x86 platform–based development environment.

Learn More

For more information, visit **intel.com/content/www/us/en/products/programmable.html**.

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