Product Brief

Intel® Xeon® Processors
Intel® Data Streaming Accelerator (Intel® DSA)

Move Data Faster with Built-in Processor Acceleration

Intel® Data Streaming Accelerator (Intel® DSA) on the latest Intel® Xeon® processors delivers peak productivity by moving data at high speeds across storage, networking, and virtual machines (VMs).

Intel DSA 2.0 on Intel Xeon 6 processors delivers up to 2x more throughput performance, with support for more operations and better copying performance to host virtual machines (VMs), compared to the previous version.[2]

With quicker insights, businesses can make better decisions. For this to happen, data must be moved efficiently within and between servers. The latest Intel Xeon processors with built-in Intel Data Streaming Accelerator (Intel DSA) help increase data throughput in the data center for fast storage, efficient networking, and high-speed analytics.

Intel DSA, part of the family of Intel® Accelerator Engines, speeds up workloads by offloading data-movement operations from the CPU. For example, when a processor receives data over a 10-gigabit connection, it can spend many cycles simply copying that data. If this type of task is instead offloaded to Intel DSA, the processor can run other tasks faster, resulting in up to 2.85x higher input/output operations per second (IOPS) and up to 65 percent latency reduction for large packet sequential read in one benchmarking test.[1]

Intel DSA was initially integrated into 4th and 5th Gen Intel Xeon Scalable processors and is now available on Intel Xeon 6 processors, which introduce a new modular x86 architecture. Intel Xeon 6 processors allow data center architects to configure and deploy infrastructures that are purpose-built for each organization's unique needs and workloads. Intel Xeon 6 processors offer the choice of two different CPU microarchitectures—Performance-cores (P-cores) and Efficient-cores (E-cores)—that provide the right amount of performance and efficiency across a wide range of workloads in the data center. Intel Xeon 6 processors with P-cores are optimized for high performance per core and excel at the widest range of workloads. Intel Xeon 6 processors with E-cores are optimized for high core density and exceptional performance per watt, delivering distinct advantages for cloud-scale workloads that demand high task-parallel throughput.

The latest version of Intel DSA on Intel Xeon 6 processors delivers up to 2x more throughput performance compared to the previous version,[2] with support for more operations and better copying performance to host virtual machines (VMs). Intel DSA 2.0 on Intel Xeon 6 processors can also access data across multiple process IDs for additional data handling, and it improves mesh bandwidth compared to the previous version.[3]

Intel DSA use cases

Developers and data architects can enable Intel DSA using Intel tools and implementation resources to optimize data movement in both new and existing applications. Intel DSA supports many use cases across the data center, storage, network, and VMs.

Table 1. Intel DSA use cases

Use case	Description
Data center	Use as a data-movement offload engine to reduce the data center tax for memory copying and zeroing to free up CPU cycles from infrastructure work.
Storage	Use for data movement in storage appliances using a Non-Transparent Bridge (NTB), both within a single node and across multiple nodes, and for cyclic redundancy check (CRC) generation and Data Integrity Field (DIF) generation, with or without simultaneously moving data.
Networking	Use for copying data in packet processing pipelines, such as for a virtual switch offload for inter-VM packet switching.
Deduplication	Use for comparing memory pages for equality to support memory deduplication.
VM migration and fast checkpointing	Use when a VM manager (VMM) must identify a VM's modified pages and efficiently send them to a destination machine.
Data movement between peer devices	Use for data movement between a peer accelerator device and host memory or between two peer devices to free up CPU cycles.
Data movement to/from/between VMs	Use to free up CPU cores from performing routine infrastructure tasks including moving data between VMs, containers, and bare-metal hosts.

Streamline integration

Developers and architects often find it overwhelming to track down the right libraries and software to implement new hardware components. Intel has streamlined the integration process for Intel DSA so that all the required tools are easily available and well-documented, as discussed in later sections of this brief. With its rich history of collaborating with open source communities, Intel helps unlock the full potential of infrastructure through multifaceted optimizations and security.

Enhance sustainability

Intel Xeon processors with Intel DSA help raise the performance-per-watt ceiling, helping organizations meet their sustainability goals. As shown in Figure 1, 4th Gen Intel Xeon Scalable processors with Intel DSA can offer up to 3.18x higher performance per watt when transforming large media files and up to 1.92x higher performance per watt when executing database requests, both as compared to out-of-box operating system (OS) software on Storage Performance Development Kit (SPDK) with NVM Express (NVMe) over TCP.[4]

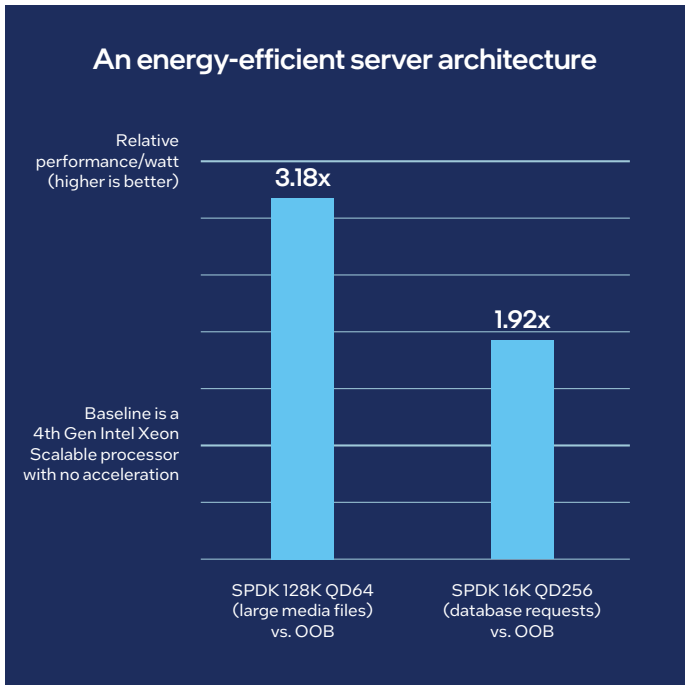

Figure 1. A more energy-efficient server[4]

Reduce TCO

By optimizing workloads with the latest Intel Xeon processor–based servers with Intel DSA, organizations can deploy fewer servers to meet the same performance requirements compared to 3rd Gen Intel Xeon Scalable processor–based servers. This server consolidation can help reduce an organization's total cost of ownership (TCO). For example, Table 2 shows that large media file requests with SPDK require 15 4th Gen Intel Xeon Scalable processor–based servers with Intel DSA, compared to 50 3rd Gen Intel Xeon Scalable processor–based servers at the same performance level.[5] The server efficiency from 4th Gen Intel Xeon Scalable processors with Intel DSA leads to a 60-percent TCO reduction compared to servers featuring the previous generation of Intel Xeon Scalable processors.[5]

Table 2. A cost-effective server achitecture that delivers the same perfomance[5]

SPDK on 4th Gen Intel Xeon Scalable processors versus 3rd Gen Intel Xeon Scalable processors	
Number of servers	15 versus 50
Fleet power	8.6 kilowatts less
CO_2 emissions	206,577 kilograms less
TCO savings	$14M (60% lower)

Enable high performance

Developers can implement Intel DSA with a wide range of Intel resources to enable high performance. Intel libraries include Intel® Data Mover Library (Intel® DML), an open source library that provides high-performance data manipulation on Intel CPUs. This library improves the performance of databases, communications, and scientific or technical applications. Learn how to optimize data manipulation and processing with Intel® Query Processing Library (Intel® QPL) and Intel DML.

Using Intel DML together with Intel DSA, developers can achieve up to 60 percent higher IOPS with NVMe over TCP and up to 37 percent latency reduction for large-packet sequential reads.[6]

Intel DSA architecture

Intel DSA offers data-mover operations and transformation operations.

Data-mover operations

Architects and developers choose Intel DSA when efficient data movement is required for workloads like storage and networking. One common data-movement function is memory copy. Figure 2 illustrates how memory copy with Intel DSA using Intel DML can reduce latency and increase memory-transfer performance.

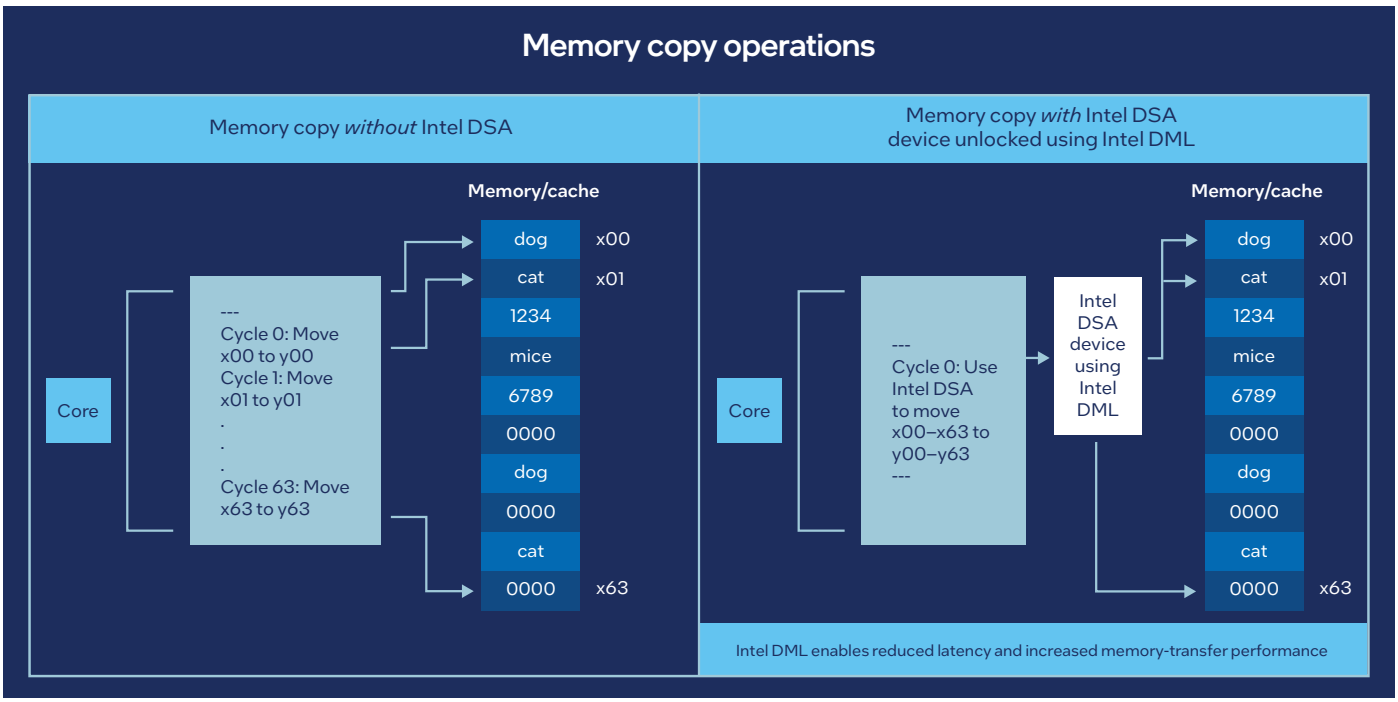

Figure 2. Memory copy with and without Intel DSA

Developers can build business applications that use Intel DSA to move data to and from volatile memory, persistent memory, and memory-mapped input/output (I/O) faster. They can also move data faster through a Non-Transparent Bridge (NTB) in a system on chip (SoC). This enables efficient transport between memory on different nodes within a cluster.

Data-transformation operations

Architects and developers can also harness Intel DSA to perform higher-level transformation operations on memory. For example, Intel DSA can generate and test cyclic redundancy check (CRC) checksums or Data Integrity Fields (DIFs) on the memory region to support storage and networking applications. Additionally, the accelerator supports a memory-compare operation for equality, generates a delta record, and applies the delta record to a buffer. Developers can use the delta record in applications such as VM migration, VM fast checkpointing, and software-managed memory deduplication.

Additional developer tools for Intel DSA

In addition to Intel DML, Intel offers a long list of tools for developers building new applications:

- Intel® Developer Zone: Official source for developing on Intel hardware
- Intel® Developer Cloud: Resources for developers to learn, prototype, test, and run workloads on a cluster of the latest Intel hardware
- Intel Developer Cloud for oneAPI: Development sandbox to learn about programming cross-architecture applications
- Intel® VTune™ Profiler: A tool that helps optimize application performance, system performance, and system configuration
- Intel DSA: Scalable I/O between accelerators and host processors: A recipe for efficient coordination between user-mode applications and accelerators for optimizing data processing

Enable Intel DSA for key workloads

Developers and architects can get started with Intel DSA using the following resources and tools, which can make it easier to implement Intel DSA in existing solutions:

- Intel DSA architecture specification: Architecture overview for Intel DSA
- Intel DSA user guide: Configuration and enablement details for Intel DSA
- Intel DSA enabling guide: Guide for effective Intel DSA enablement on 4th Gen Intel Xeon Scalable processors
- Intel DSA for packet copy offload in OVS: Guide for using Intel DSA for packet-offload capabilities

Accelerate business workloads

The following scenarios illustrate how the latest Intel Xeon processors with Intel DSA can accelerate network storage applications, software-defined networking (SDN), and video streaming. Workload-specific resources are provided.

Network storage applications

Use SPDK NVMe with Intel DSA to build applications that require high-speed storage, including databases or virtualized storage, or to create software components like data caches.

Use 4th Gen Intel Xeon Scalable processors with Intel DSA to:

- Deliver up to 60 percent lower TCO at the same performance level using integrated Intel DSA implemented with SPDK NVMe, compared to 3rd Gen Intel Xeon Scalable processors.[5]

Use 5th Gen Intel Xeon Platinum 8592+ processors with integrated Intel DSA to:

- Increase performance by up to 2.26x and increase performance per watt by up to 2.15x for large packet sequential read, compared to out-of-the-box (OOB) software.[1]
- Increase IOPS by up to 2.51x and achieve up to 60 percent latency reduction for large packet sequential reads, compared to OOB 4th Generation AMD EPYC 9554 processors.[7]

Implementation and adoption resources

- Intel DSA for SPDK documentation hub: Holistic overview for using SPDK with Intel DSA
- Intel DSA for SPDK presentation: Capabilities presentation for Intel DSA, including SPDK as a workload
- Intel DSA for SPDK framework and enablement: Public event presentation featuring Intel DSA capabilities for SPDK, including Intel DML

Coding resources

- SPDK code: GitHub source code and support for SPDK

Software-defined networking

SDN enables faster packet processing. Pair Project Calico and Vector Packet Processing (VPP) with Intel DSA to create applications with optimized networking capabilities that accelerate service delivery.

Use 4th Gen Intel Xeon Scalable processors with Intel DSA to deliver up to:

- 2.33x (1,500 MTU, 1,500 B) and 2.63x (9,000 MTU, 2,400 B) higher single-core throughput versus software-based memory copy.[8]

Implementation and adoption resources

- Calico VPP with Intel DSA solution overview: Overview for using Intel DSA for Calico VPP performance

Coding resources

- Calico VPP code: GitHub source code and support for Calico VPP

Video streaming

ST-2110 standard video streaming protocol, Data Plane Development Kit (DPDK) libraries, and the Intel® Ethernet Network Adapter E810 work together with Intel DSA to accelerate video streaming. This synergy increases core efficiency and system scalability, allowing the protocol to be used to accelerate broadcasting workflows, to enhance sports broadcasts, concerts, and news coverage, and to enable professional video production.

Intel DSA improves performance in video streaming use cases by offloading packet-copy operations from the latest Intel Xeon processors.

Implementation and adoption resources

- Real-time video transport with Intel DSA solution overview: Enhance video processing workload performance with Intel DSA

Container details

- Intel V Tune Profiler for Docker containers: Recipe for additional support of Intel DSA for intensive media applications

Coding resources

- Intel® Media Transport Library code: Source code for Intel Media Transport Library in support of Intel DSA

Faster time to insights

Harness the latest Intel Xeon processors with built-in Intel DSA to optimize data movement and transformation operations. Move data efficiently within and between servers to accelerate storage, networking, and analytics. Faster data movement means faster time to data insights and better business results.

Learn more about 4th Gen Intel Xeon Scalable processors, 5th Gen Intel Xeon processors, Intel Xeon 6 processors, and Intel® Accelerator Engines.

intel XEON

[1] See [N16] at intel.com/processorclaims: 5th Gen Intel Xeon Scalable processors. Results may vary.
[2] Based on Intel internal assessment.
[3] Based on Intel internal assessment.
[4] See [E1] at intel.com/processorclaims: 4th Gen Intel Xeon Scalable processors. Results may vary.
[5] See [E10] at intel.com/processorclaims: 4th Gen Intel Xeon Scalable processors. Results may vary.
[6] See [N18] at intel.com/processorclaims: 4th Gen Intel Xeon Scalable processors. Results may vary.
[7] See [N201] at intel.com/processorclaims: 5th Gen Intel Xeon processors. Results may vary.
[8] See [W7] at intel.com/processorclaims: 4th Gen Intel Xeon Scalable processors. Results may vary.

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