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# Deterministic Performance Optimized for the Edge

Intel® Xeon® D-2700 and D-1700 processors deliver breakthrough, density-optimized performance, scalability, and value for cloud, edge, and 5G networks. Intel Xeon D processors with integrated Ethernet and accelerators for the edge support networking, storage, industrial IoT, the data center edge, and more.

The ongoing drive to process workloads closer to the point of data origin creates requirements for compute at the edge. Delivering performance and security while meeting power and space constraints is key to taking full advantage of network edge usage models for benefits such as low latency and reduced costs for backhaul bandwidth. Advanced systems architectures that are optimized for edge computing and other distributed environments are enabling the push of data center resources outward, for implementations and use cases such as:

- **Networking**, including gateways and routers, security appliances, and storage
- **5G topologies**, including C-RAN and D-RAN architectures
- **Security**, including Secure Access Service Edge (SASE)
- **IoT**, including smart operations

The age of deploying fixed-function devices to fill these roles has passed. General-purpose, open-standards systems based on Intel architecture offer a flexible, cost-effective foundation for the next-generation edge, including artificial intelligence (AI) in edge devices and appliances.
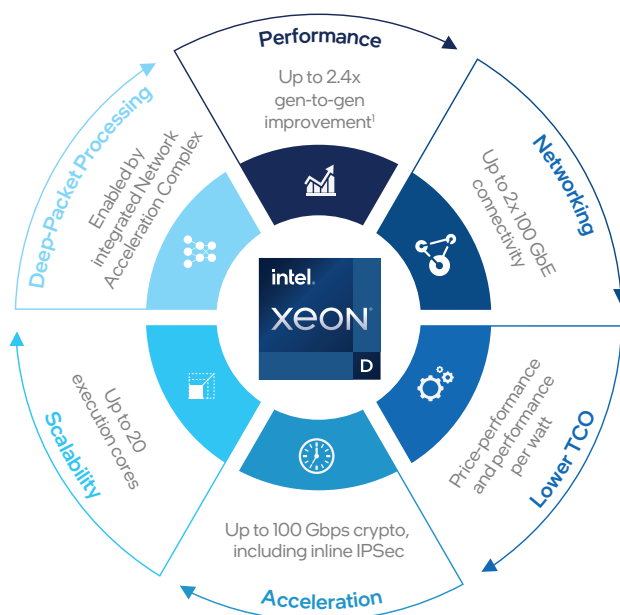
Introducing the Intel® Xeon® D-2700 and D-1700 Processors

Intel Xeon D-2700 and D-1700 processors are designed for provisioning dense compute at the edge that balances high computational throughput with low thermal design power (TDP). High per-core performance, advanced security features, and built-in hardware acceleration for crypto, AI, and compression support the requirements of demanding workloads within a density-optimized platform. The highly integrated design is packaged as a system-on-chip (SoC) based on a ball grid array (BGA) package for ease of design-in and power efficiency.

The highly integrated design is well suited to the development of compact solutions for deployments targeting indoor, outdoor, and ruggedized environments, complemented by a newly extended range of operating temperatures. The SoC is also fully compatible with software and APIs across previous generations of Intel Xeon processors, as well as other Intel architecture and solutions. The resulting ease of design, development, and integration into existing Intel solutions enables low total cost of ownership and fast time to market for updated product offerings.

Compute Performance

Solutions benefit from a range of hardware technologies built into the Intel Xeon D-2700 and D-1700 processors to accelerate workloads, including the following:

- **Intel® Deep Learning Boost (Intel® DL Boost)** accelerates AI workloads by eliminating unneeded precision in calculations so they can be completed more quickly.

- **Intel® AES New Instructions (Intel® AES-NI)** accelerate resource-intensive parts of the AES encryption algorithm in hardware.

- **Intel® Advanced Vector Extensions 512 (Intel® AVX-512)** boosts performance for demanding requirements such as AI and 5G workloads with ultra-wide 512-bit vector operations that work on more data per clock cycle than predecessor technologies.

- **Intel® QuickAssist Technology (Intel® QAT) with inline IPSec support** accelerates encryption and compression; the platform is capable of driving up to 100 Gbps crypto and 70 Gbps compression. The crypto capability also includes inline IPSec, which enables customers to free up precious compute cores for other applications.

Hardware-Based Security Innovations

In addition to crypto acceleration from Intel AES-NI and Intel QAT, the Intel Xeon D-2700 and D-1700 processors provide solution makers with cutting-edge security features built into the hardware that includes the following:

- **Intel® Software Guard Extensions (Intel® SGX)** protects data while in use by creating private, isolated areas of memory called *secure execution enclaves* where unencrypted data can be operated on, beyond the reach of software and users, regardless of their privilege levels.

- **Memory Encryption** supports existing software without modification while cryptographically protecting memory against hardware attacks using the NIST AES XTS encryption standard with hardware-generated keys from a hardened random-number generator implemented in silicon.

Advanced Integrated Ethernet Connectivity

Integrated Ethernet provides up to 100 Gbps of throughput, with connectivity options that offer links from 1GbE to 100GbE. For storage networking, the SoC platform provides Remote Direct Memory Access (RDMA) for memory transfers between systems that bypass the operating system, increasing throughput and reducing processor overhead and latency. RDMA capabilities include support for both Internet Wide Area RDMA Protocol (iWARP) and RoCEv2 (RDMA over Converged Enhanced Ethernet). This flexibility of transport protocols supports topologies of choice for storage architects.

The integrated NIC supports Dynamic Device Personalization (DDP) to provide multiple profiles that each specify optimizations and packet-handling parameters for specific traffic types, for increased throughput and traffic prioritization. Application Device Queues (ADQ) enables specific applications to reserve any number of dedicated Ethernet hardware queues, helping ensure predictable performance.

Integrated Ethernet functionality also includes an Enhanced Packet Processor component called the Network Acceleration Complex (NAC). The NAC is the next step in the evolution of packet processing and switching acceleration; it integrates the following:

- **Network interface with enhanced scheduler** that provides up to 100 Gbps of host throughput

- **Flexible packet processor and switch** accelerate inline packet processing

- **Flexible connections**, with up to eight ports at 25, 10, or 1 Gbps

Implementation Flexibility: One Architecture, Two Package Options

To broaden the range of usage models, the Intel Xeon SoC is available in two distinct packages: the high-core-count Intel Xeon D-2700 processor, optimized for performance, and the Intel Xeon D-1700 processor, which is optimized for cost and power consumption. The two options provide flexibility in the deployment of high-density compute and networking for various usage models.

Advanced Package (High Core Count): Intel Xeon D-2700 Processors

With 4–20 cores, the Advanced SoC package based on the Intel Xeon D-2700 processor is suited to demanding workloads, such as handling high data plane throughput. It operates at higher TDP than the Intel Xeon D-1700 processor and features higher memory performance and capacity, more PCI Express lanes, higher-bandwidth crypto, and compression through the Intel QAT accelerator. In addition, the Intel Xeon D-2700 processors have support for NAC with inline IPSec.

Standard Package (Low Core Count): Intel Xeon D-1700 Processors

Featuring 2–10 cores depending on the specific SKU, the Standard SoC package based on the Intel Xeon D-1700 processor is often deployed for control plane functions, as well as for lower-throughput usages such as customer premise equipment.

Upgrade Path from Previous Intel Xeon D Processors

The Intel Xeon D-2700 processors are the successors to Intel Xeon D-2100 processors, while the Intel Xeon D-1700 processors replace Intel Xeon D-1500 and D-1600 processors. In all cases, the upgrades provide significant, balanced, cost-effective improvements across compute, memory, and I/O.

Performance Optimized
(High Core Count)

Intel® Xeon® D-2100 processors
(52.5 mm x 45 mm package)

Ethernet Throughput from 40GbE(Intel® Xeon® D Processor D-2100) to 100GbE(Intel® Xeon® Processor D-2700)

Ethernet Connectivity from 4x 10GbE(Intel® Xeon® D Processor D-2100) to 2x 100GbE (Intel® Xeon® Processor D-2700)

Memory Bandwidth from 2900 Mtps (Intel® Xeon® D Processor D-2100) to 3200 Mtps (Intel® Xeon® Processor D-2700)

PCIe Throughput from PCIe 3.0 (Intel® Xeon® D Processor D-2100) to PCIe 4.0 (Intel® Xeon® Processor D-2700)

Intel® Xeon® D-2700 processors
(52.5 mm x 45 mm package)

Cost and Power Optimized
(Low Core Count)

Intel® Xeon® D-1500 & D-1600 processors
(37.5 mm x 37.5 mm package)

Ethernet Throughput from 20GbE (Intel® Xeon® D Processor D-1500) to 25GbE (Intel® Xeon® Processor D-1700)

Ethernet Connectivity from 2x 10GbE (Intel® Xeon® D Processor D-1500) to up to 2x 25GbE (Intel® Xeon® Processor D-1700)[2]

Memory Bandwidth from 2400 Mtps (Intel® Xeon® D Processor D-1500) to 2933 Mtps (Intel® Xeon® Processor D-1700)

PCIe Throughput from PCIe 3.0 (Intel® Xeon® D Processor D-1500) to PCIe 4.0 (Intel® Xeon® Processor D-1700)

Intel® Xeon® D-1700 processors
(45 mm x 45 mm package)

Benefits Across Edge Workloads

For edge computing, the Intel Xeon D-2700 and D-1700 processors are more cost-effective, scalable, and secure than their predecessors.

Generation-over-Generation Performance Improvements

• **Higher signaling and user-plane throughput** enabled by an advanced microarchitecture

• **Data Plane Development Kit (DPDK) advantage** from new Intel® AVX-512 instructions and built-in accelerators

Integrated High-Throughput Networking with Advanced Secure Connectivity

• **Up to eight Ethernet ports** with up to 100 Gbps packet processing capabilities with inline IPSec

• **Assured support for line-rate requirements** while adding more value via additional services and features

Lower Total Cost of Ownership

• **Increased I/O bandwidth** provided by PCIe 4.0 (16 GT/s) with up to 32 lanes

• **Increased subscriber workload per node**, for cost-effective deployment of advanced services

Integrated Cryptographic and AI Accelerators

• **Improved Intel QAT** offers better acceleration compared to previous generation

• **New instructions for AI** accelerate AI/deep learning workloads

Scalability up to 20 Cores

• **Single standard architecture** for NFV product portfolio, including Intel Xeon Scalable processors

• **Reduced total platform investment** with application, control, and data plane workload consolidation, with software back-compatibility
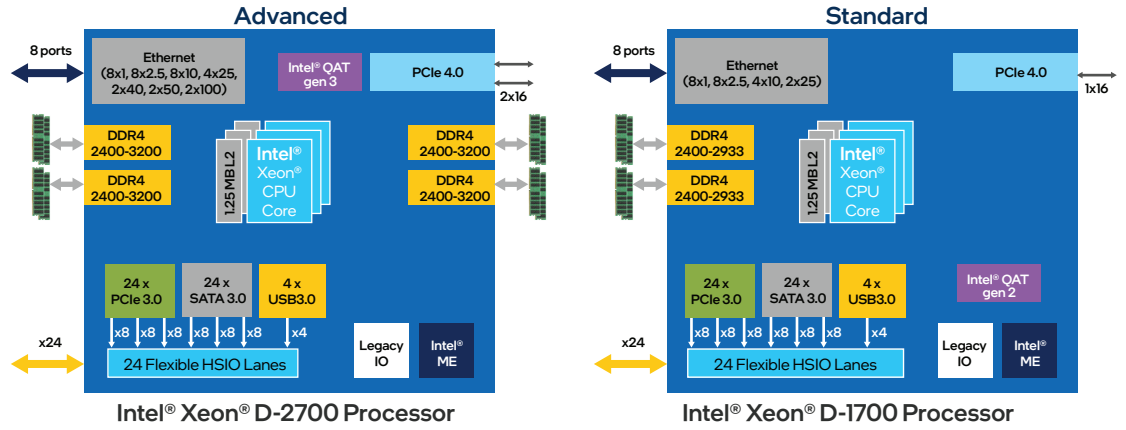
Advanced Features for Edge Deployments

The expanding range and importance of usages puts increasing demands on compute resources provisioned at the edge for performance, manageability, and data protection. Intel Xeon D processors provide new hardware-based technologies that accelerate workloads, streamline maintenance, and enhance security.

New Technology		Benefit
Core Acceleration	Vector Byte Manipulation Instructions (VBMI)	InCore compression/decompression acceleration for in-memory database workloads
	VPMADD52 instruction	Public key crypto generation – SSL front end web server acceleration
	New SHA extensions	Acceleration of hashing, SSL, TLS, IPsec, dedup, blockchain
	Vector AES	Database workloads acceleration
Performance Tuning and Management	Intel® Resource Director Technology (Intel® RDT)	Monitoring and control of memory and Last Level Cache usage
	Flexible All Core Turbo[2] and Prioritized Base Frequency[2]	Higher frequencies for a subset of cores while all cores are active to manage application-level performance
	Intel Speed Select[2]	Higher base frequency at lower core counts for dynamic SKUing
	Internal block grounding	Power optimized sub-segment SKUing
	Virtualization improvements	Enhancing performance of NFV workloads
	Asynchronous DRAM Refresh (ADR)	ADR with enhanced battery backup significantly decreases battery size requirements
Security	Intel® SGX-Trusted Environment Mode (Intel® SGX-TEM)	Fine grain data protection by means of application isolation in memory
	Intel® Total Memory Encryption – Multi-Tenant (Intel® TME-MT)	VM container isolation for multi-tenant platforms
	Intel® Platform Firmware Resilience (Intel® PFR)	Protect, detect, and correct security threats in transit, boot, and runtime
	New algorithms in Intel® QAT gen 3	SHA3, SM3, SM4, ChachaPoly added to accelerate IPsec, TLS, and DTLS workloads
Artificial Intelligence (AI)	Intel® Advanced Vector Extensions 512 (Intel® AVX-512)	Accelerates performance of computationally intensive workloads including AI/deep learning, scientific simulations, and financial analytics
	Vector Neural Network Instructions (VNNI)	Delivers significant deep learning acceleration and power savings through the use of a single vector instruction set

Package Specifications: Advanced versus Standard

The Intel Xeon D-2700 and D-1700 processors are similar in design but differentiated in physical form factor, core count, total design power, and other features. These differences in specifications allow the SoCs to be matched to usages with the corresponding performance, cost, space, and power requirements and constraints.

Intel® Xeon® D-2700 Processor | Intel® Xeon® D-1700 Processor

	Advanced	Standard
Socket	SoC: Flip Chip Ball Grid Array (FCBGA) 52.5 mm x 45 mm	SoC: Flip Chip Ball Grid Array (FCBGA) 45 mm x 45 mm
Cores	4–20 with Intel® Hyper-Threading Technology	2–10 with Intel® Hyper-Threading Technology
Cache	LLC: 1.5 MB/core (max 30 MB) MLC: 1.25 MB/core	LLC: 1.5 MB/core (max 15 MB) MLC: 1.25 MB/core
Thermal Design Power (TDP)	64–125 watts	25–85 watts
Memory	4 channels DDR4 (2933 MT/s 2DIMMs per Channel, 3200 MT/s 1 DIMM per Channel) 8 Gb and 16 Gb density Up to 512 GB capacity with RDIMM[3]	2 or 3 channels DDR4 up to 2933 MT/s, 1 and 2 DIMMs per Channel 8 Gb and 16 Gb density Up to 384 GB capacity with RDIMM[3]
Integrated Intel® Ethernet	Up to 100 Gbps throughput options Connectivity: 1, 2.5, 10, 25, 40, 50, 100 GbE with RDMA (iWARP and RoCE v2)[4]	Up to 100 Gbps throughput options Connectivity: 1, 2.5, 10, 25, 40 GbE with RDMA (iWARP and RoCE v2)[4]
Integrated Intel® QAT	Intel® QAT gen 3: Up to 100 Gbps Crypto Up to 70 Gbps Compression 80kOps PKE RSA 2K	Intel® QAT gen 2: Up to 20 Gbps Crypto Up to 15 Gbps Compression 20kOps PKE RSA 2K
PCI Express	Total of 56 lanes thru combining 32 PCIe 4.0 + 24 HSIO PCIe 3.0 32 PCIe 4.0 full BW dedicated lanes from CPU complex (eight root ports) Bifurcation: x16, x8, x4 NTB via PCI 4.0 lanes: x16 and x8	Total of 40 lanes thru combining 16 PCIe 4.0 + 24 HSIO PCIe 3.0 16 PCIe 4.0 full BW dedicated lanes from CPU complex (four root ports) Bifurcation: x16, x8, x4 NTB via PCI 4.0 lanes: x16 and x8
SATA Support	Up to 24x SATA 3.0 over HSIO	
High-Speed Flexible I/O	24 High-Speed Flexible I/O Lanes configured as PCIe/SATA/USB Up to 24 lanes of PCIe 3.0 (2.5, 5, 8 GT/s, Bifurcation support: x8, x4, x2; 12 root ports) or up to 24 SATA 3.0, or up to four ports of USB 3.0 Combined HSIO bandwidth is limited to equivalent 16 PCIe 3.0 lanes of traffic	
Other Features	UART, LPC, SPI, eMMC 5.1, 2x USB 2.0, Intel® ME (Manageability Engine), SGX, TME-MT, PFR	

The Intel Processor Portfolio for Edge Computing

Open systems built on Intel® processors allow architects to tailor their solutions to the level of compute and performance that is needed, while allowing for implementation-specific space and power constraints. Intel Xeon D Processors participate in Intel's broader edge processor portfolio, which also includes Intel Xeon Scalable processors and Intel Atom® C3000 processors. Together, these processor families meet the full spectrum of edge compute requirements, with full software compatibility across the portfolio.

Intel® Xeon® Scalable Processors
Best Performance,
Most Scalable

Designed for Edge environments with flexible operating space and power

Intel® Xeon® D Processors
Optimized for Density
and Lower Power

Designed for Edge environments constrained by operating space and power

Intel® Atom® C3000 Processors
Designed for
Very Low Power

Designed for Edge environments constrained by physical size and extreme temperatures

More Information: **www.intel.com/xeond**