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Power-efficient Performance for Networking Equipment, Security Accelerators, and Storage

Intel Atom® C5000, P5300, and P5700 processors enable businesses to optimize the balance of performance and cost for modern network infrastructure, security accelerators, and storage appliances.

Network transformation continues to accelerate the pace of IT change, and today's distributed networks have redefined the cybersecurity landscape. Zero-trust network access (ZTNA) is increasingly a foundational requirement for enterprises, where users, applications, and services are explicitly untrusted and every access request must be individually authorized and validated. Architects must now update older hub-and-spoke models—where all access was funneled through centralized security services—with distributed security topologies.

IT is transitioning from single-function monolithic security and networking devices to open solutions running on general-purpose hardware. Traditionally, specialized hardware and software stacks were optimized for specific network and security functions such as routers, VPNs, and firewalls. The role-specific proprietary devices were expensive and inflexible, without the ability to share headroom when responding to dynamic traffic changes. Single-function devices also tended to create management silos that created operational inefficiencies.

Modern cloud-native network functions (CNFs) deliver networking and security capabilities as virtualized software entities, centrally orchestrated across the environment. This topology enhances efficiency and agility, with distributed security functions protecting workloads as they pass among on-premises, hosted, and public-cloud infrastructure. Intel Atom processors deliver features and performance matching legacy single-purpose solutions, including for edge implementations constrained by physical size and extreme temperatures.

Introducing the Intel Atom C5000, P5300, and P5700 Processors

Intel Atom processors are available with a broad range of core counts and hardware features to support different edge use cases. Advanced microarchitectures based on 10nm process technology and a robust set of accelerators combine to deliver high per-core performance and advanced packet processing. The platforms are based on energy efficient system-on-chip (SoC) form factors with integrated Intel® Ethernet and Intel® QuickAssist Technology (Intel QAT), ensuring high performance per watt for network edge implementations.

	Intel Atom® C5000 Processors	Intel Atom® P5300 Processors	Intel Atom® P5700 Processors
Cores	4–8	8–24	8–20
Operating Temperature Range	Extended and commercial	Extended	
Integrated LAN	Up to 8 Ethernet ports Up to 50 Gb throughput	Up to 8 Ethernet ports Up to 100 Gb throughput	
Integrated Switch	No	No	Flexible packet processor and switch
Accelerators	Intel® QAT Gen2: 20 Gb crypto throughput (look-aside only)	Intel QAT Gen3: 100 Gb crypto throughput (look-aside only) Intel Dynamic Load Balancer	Intel QAT Gen3: 100 Gb crypto throughput (inline and look-aside) Intel Dynamic Load Balancer

The flexibility of these open standards platforms is enhanced by Intel's unmatched software and solution ecosystem. Software compatibility across Intel architecture enables solutions to scale upward using Intel® Xeon® D and Intel® Xeon® Scalable processors.

Power-Optimized for Networking and Storage: Intel Atom C5000 SoCs

The Intel Atom C5000 processor series includes the Intel Atom C5100 series processors for storage and the Intel Atom C5300 processors for networking. Both include 4 to 8 cores and feature integrated Intel QAT Gen2, which is capable of 10 to 20 Gbps look-aside encryption throughput. The Intel Atom C5000 processors are socket-compatible with the Intel Atom P5300 and P5700 SoCs to enhance platform upgradeability.

- **Intel Atom C5100 processors** support storage applications for on-premises physical storage appliances that serve the small and midsize business (SMB) segment. They have a thermal design power (TDP) of 42 to 50 watts, no integrated Ethernet, and commercial temperature range operation.

- **Intel Atom C5300 processors** are built for networking applications, have a TDP of 32 to 41 watts, and include both extended and commercial temperature options, enabling the choice of processor SKU to be tailored to the implementation scenario.

Performance-Optimized: Intel Atom P5300 SoCs

Intel Atom P5300 processors are based on 8 to 24 cores and operate with a TDP of 55 to 85 watts. The platform is engineered to provide power-efficient computing for implementations such as network and security appliances or SD-WAN points of presence (POPs). It integrates Intel QAT Gen3, which is capable of driving 100 Gbps of crypto and 70 Gbps of compression, and supports extended temperature operation.

Compute Platforms for Extended Temperature Operation[1]

Equipment deployed at the network and edge must function in locations that are far removed from climate-controlled server rooms. Extended temperature operation helps ensure reliability in environments that can range from a branch office closet to extreme conditions outdoors or in an industrial facility, from -40 to 85 degrees Celsius with full dynamic temperature range.

Performance-Optimized with Integrated Switch: Intel Atom P5700 SoCs

Intel Atom P5700 processors provide 8 to 20 cores, a power envelope of 48 to 75 watts, and extended temperature operation. The eight-port switch integrated into the Intel Atom P5700 processors provides a sophisticated 100 or 200 GbE programmable packet-processing pipeline and packet classifiers for advanced traffic management. This class of functionality is typically associated with higher-end network switches. Integrating the hardware resources into the SoC package provides cost and space efficiencies comparable to an external switch.

Intel Atom P5700 processors use an integrated network switch and Intel QAT Gen3 to support inline IPsec.

The integrated switch enables inline crypto, which can dramatically reduce latency in network security implementations, compared to the look-aside model used in Intel Atom C5000 and P5300 processors. In the look-aside model, the Ethernet complex transfers all incoming data to system memory, where the CPU makes the decision about which packets to offload to the Intel QAT hardware. While this approach is appropriate for asynchronous usages such as bulk cryptography, it incurs latency that is incompatible with real-time workflows such as IPsec.

Intel Atom P5700 processors apply switching functionality and Intel QAT Gen3 to support inline IPsec. The Intel QAT hardware communicates directly with the Ethernet controller to decide which packets to process and which to pass on to the processor, reducing CPU-bound operations in the data path. This refactoring of traffic and workload handling accelerates authentication and encryption tasks and improves VPN tunneling performance.

Platform Accelerations for Security, Networking, and Storage[1]

Intel Atom C5000, P5300, and P5700 processor SKUs provide customers with tailored solutions for specific requirements. Optimizations based on the data plane development kit (DPDK) offload TCP packet processing from the kernel to user-space processes. This workload redirection avoids the performance impacts of CPU interrupts, driving up compute efficiency and network throughput.

Networking Equipment
- Control Plane
- Branch Office Router
- Edge Router
- Router Services Module
- uCPE/SD-WAN

Security Appliances
- Next Generation Firewall
- Function Offload & Acceleration
- Intrustion Detection/ Prevention
- Content Security
- Application Delivery

Storage Devices
- Energy Efficient Entry Storage
- Entry SAN/NAS
- Cold Storage

DPDK is a key enabling technology for Intel Atom platforms to converge the data plane with a single architecture to handle diverse packet-processing workloads. This standardization replaces legacy approaches that required many different (often custom) silicon components such as NPUs and ASICs. Intel Atom platforms utilize a combination of platform ingredients, software optimizations, and ecosystem support to accelerate packet processing.

- **Intel Dynamic Load Balancer** (Intel DLB) handles millions of queue-management operations per second to efficiently distribute network processing across CPU cores, with dynamic load balancing as traffic levels vary. Managing network queues in hardware frees up processor cycles traditionally consumed by software-based queueing.

- **Intel Ethernet 800 Series technology** integrated into the SoC provides up to 100 Gbps of throughput, with link options from 1GbE to 100GbE and support for advanced traffic handling features across packet types. Intel Ethernet 800 series is integrated into the Intel Atom C5300, P5300, and P5700 processors.

- **Intel Network Acceleration Complex (NAC)** enables high-performance Ethernet I/O and switching with accelerated inline packet processing and an enhanced scheduler, for higher throughput with security functions such as authentication and encryption/decryption.

- **Intel QAT** accelerates symmetric and asymmetric encryption as well as lossless compression in hardware, freeing up CPU resources for other work. Intel QAT Gen3, supported by the Intel Atom P5300 and P5700 processors, offers the latest algorithms and increased throughput over Intel QAT Gen2, which is supported by the Intel Atom C5000 processors.

- **Intel QuickData Technology** enables data copy by the chipset instead of the CPU, to move data more efficiently through the server and provide fast, scalable, and reliable throughput.

Product Variants

To flexibly support networking, security acceleration, and storage use cases, Intel Atom processors provide a range of hardware features and other resources.

Intel® NetSec Accelerator Reference Design

The Intel NetSec Accelerator Reference Design is a PCIe add-in card based on the Intel Atom® P5700 processor and the Intel® Ethernet Adapter E810. A complete server on a card, the product enables security appliances to offload processor-intensive workloads such as IPsec, firewall, cryptography, and SASE to free up resources for other network or edge applications and workloads.

https://www.intel.com/content/www/us/en/products/docs/processors/atom/netsec-accelerator-reference-design-solution-brief.html

	Intel Atom® C5100 Processors: Storage	Intel Atom® C5300 Processors: Network Mode	Intel Atom® P5300 processors: NIC (NS) Mode	Intel Atom® P5700 processors: Switch (NX) Mode
Cores	4–8		8–24	8-20
Cache	32kB L1/core + 4.5 MB L2 cache per 4-core cluster + up to 7.5 MB of shared LLC		32kB L1/core + 4.5 MB L2 cache per 4-core cluster + up to 15 MB of shared LLC	
Addressing	42-bit PA / 48-bit VA			
Memory Support	DDR4 2400/2667/2933, 2 channels 64 bits, 1–2DPC		DDR4 2133/2400/2667/2933, 2 channels 64 bits, 1–2DPC	
Memory Types	RDIMM, UDIMM, SODIMM, Memory Down			
Server-Class RAS	Enhanced ECC SEC-DED covers address and data paths, DDR scrambler to reduce error rate, Error injection, HW based Demand and Patrol engine, PCIe End-To-End CRC			
PCIe 3.0	Up to 4 RPs and 16 lanes – x8, x4, x2	---	Up to 4 RPs and 16 lanes of PCIe 3.0 (x16, x8, x4)	
Flexible I/O	16 High-Speed Flexible Lanes configured as PCIe, SATA, and USB3			
PCIe 3.0**	Up to 8 RPs and 16 lanes – x8, x4, x2 (depends on flexible I/O)			
SATA 3.0**	Up to 16 ports (depends on flexible I/O)			
USB 3.0	Up to 4 ports (depends on flexible I/O)			
Additional Peripherals	Up to 4 USB 2.0 ports, eMMC 5.1, LPC or eSPI (shared pins)			
Networking	---	Up to 8 Eth SerDes supporting 4x10G / 2.5G / 1G, 8x10G / 2.5G / 1G	Up to 8 Eth SerDes supporting 1x100G, 2x50G, 4x25G / 10G / 2.5G / 1G, 8x10G / 2.5G / 1G	Up to 8 Eth SerDes supporting 2x100G (active failover only), 2x50G, 8x25G / 10G / 2.5G / 1G; Inline Crypto
Acceleration (Converged Packet Processing Architecture)	Intel® QAT Gen2 Intel QuickData Technology	Intel Ethernet 800 Series technology Intel QAT Gen2 Intel QuickData Technology	Intel Dynamic Load Balancer (Intel DLB) Intel Ethernet 800 Series technology Intel QAT Gen3 Intel QuickData Technology	Intel Dynamic Load Balancer (Intel DLB) Intel Ethernet 800 Series technology Flexible Packet Processor & Switch Intel QAT Gen3 Intel QuickData Technology
Additional Technologies	Intel VT-x, VT-d, SR-IOV, VMDQ, Intel Boot Guard, Co-Signed Verified Boot, Intel TXT, Intel Platform Trust Technology	Intel VT-x, VT-d, SR-IOV, VMDQ, Intel Boot Guard, Intel TXT, Intel Platform Trust Technology	Intel VT-x, SR-IOV, VMDQ, Intel Boot Guard, Co-Signed Verified Boot, Intel TXT, Intel Platform Trust Technology	
Manageability	Intel Management Engine (Intel ME)			
Package	47.5 x 47.5mm FCBGA			
Operating Temperature	Commercial temp	Extended temp (-40° C to 85° C) with full dynamic temperature range (on select SKUs)	Extended temp (-40° C to 85° C) with full dynamic temperature range	

More Information at www.intel.com/atom