Platform Brief

Intel Atom® x6000E Series Processors
Intel® Pentium® N and J Series Processors
Intel® Celeron® N and J Series Processors

intel.

Driving performance, integration, and versatility with Intel's first Enhanced for IoT platform

Enhanced for IoT, Intel Atom® x6000E Series and Intel® Pentium® and Celeron® N and J Series processors deliver next-generation CPU and graphics performance with integrated support for real-time computing and Ethernet, functional safety, and industrial-centric I/Os.[1,2]
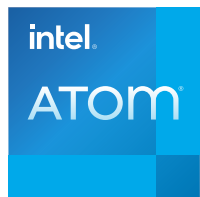
Addressing the explosive growth of edge computing

The continued growth of computing at the edge is driving IoT devices to support more connectivity, more bandwidth, and higher levels of security—all while reducing latency. Up to 70 percent of enterprises will run varying levels of data processing at the IoT edge by 2023.[3]

To support the next generation of IoT edge devices, Intel has developed a new line of processors enhanced for IoT: The Intel Atom® x6000E Series and Intel® Pentium® and Intel® Celeron® N and J Series processors. These processors build on new levels of CPU and graphics performance with integrated IoT features, real-time performance, manageability, security, and functional safety.[1,2]

Product overview

To enhance workload consolidation and meet IoT-centric requirements, Intel is introducing the Intel® Programmable Services Engine (Intel® PSE). It facilitates numerous new functions; supports real-time, ARM-based applications; and manages industrial I/Os. The integrated Intel® Safety Island supports functional safety, orchestrates Intel-on-chip diagnostics, reports errors, and monitors customer-safety applications.[1,2]

With a choice of 12 pin-compatible options, these Intel Atom, Pentium, and Celeron processors offer a broad range of dual- or quad-core options running up to 3.0 GHz with support for both DDR4 and LPDDR4/x memory in up to 64 GB configurations. TDP ranges between 4.5W and 12W allow for implementation into a variety of design form factors with passive or active thermal solutions.

Bring next-generation graphics to the edge

These processors take a huge leap forward in graphics capabilities with Intel® UHD Graphics. Supporting eDP, DP, HDMI 2.0b, and MIPI DSI interfaces, the platform can drive a maximum resolution of 4K progressive scan at 60fps on up to three simultaneous displays, a first for this family of processors.

Integration and flexibility for IoT: The Intel® Programmable Services Engine

The Intel Programmable Services Engine (Intel PSE) is a dedicated offload engine for IoT functions powered by an ARM Cortex-M7 microcontroller. It provides independent, low-DMIPS computing and low-speed I/Os for IoT applications, plus dedicated services for real-time computing and time-sensitive synchronization.

The Intel PSE hosts new functions, including remote out-of-band device management, network proxy, embedded controller lite, and sensor hub. Flexible programming, using open source code or prebuilt firmware binaries, lets you configure the Intel PSE to meet your application requirements and run real-time, ARM-based applications.

Manage devices even when the OS is unresponsive

The platform provides both remote out-of-band (OOB) and in-band (INB) device management for monitoring and remotely managing devices throughout their lifecycle. OOB management provides power control for edge devices even when the OS is unresponsive. You can restart, power down, or power up from sleep states. The INB framework facilitates over-the-air firmware and software updates while the OS is responsive. These management tools can be implemented independently of each other for your use case.

Meet strict functional safety (FuSa) requirements: Intel® Safety Island[1]

Intel Atom® x6427FE and x6200FE processors meet IEC 61508 and ISO 13849 requirements (SIL2/Cat.3 PL d certified[8], SIL3/Cat.4 PL e capable) for functional safety. Functional safety capabilities and highly reliable performance are built into the silicon, along with a complete set of technical documentation—safety manual, safety analysis, and user guides—which makes the customer certification process faster and simpler.

Deploy real-time computing solutions for worst-case execution-time operations and ultrareliable low-latency communication[2]

Intel Atom® x6000RE and Intel Atom x6000FE Series industrial processors support Intel® Time Coordinated Computing (Intel® TCC) and Time-Sensitive Networking (TSN). These technologies improve worst-case execution-time operation within individual processors and system-wide by synchronizing data, communications, and executions across networks of IoT devices.

Hardened security to help protect edge devices

Hardware-based security measures help mitigate firmware, code, and data attacks while dedicated cryptography accelerators speed up data encryption without impacting overall system performance.

Use-case possibilities

Practically any industry, sector, or application that needs higher-performance computing and graphics in a low-power design can benefit from this platform. Optional features for real-time computing and functional safety extend the platform's capabilities to critical control systems and industrial automation.

Here are a few examples:

- Real-time control systems and devices that meet functional safety requirements for industrial robots and for chemical, oil field, and energy-grid control applications
- Vehicle controls, fleet monitoring, and management systems that synchronize inputs from multiple sensors and direct actions in semiautonomous buses, trains, ships, and trucks
- Medical displays, carts, service robots, entry-level ultrasound machines, gateways, and kiosks that require AI and computer vision with reduced energy consumption
- Fixed and mobile point-of-sale (POS) systems for retail and quick-service restaurants (QSR) with high-resolution graphics
- Multifunction print/scan/copy machines that deliver rich user experiences, hardware-based data security, and remote management

Get to market faster with Intel partners and solutions

Intel is part of a large and expanding ecosystem that is driving innovation at the edge. Intel and our IoT technology partners work together to help you build and deploy high-performance, embedded devices.

Intel® IoT Solutions Alliance can help you accelerate design and deployment of intelligent devices and analytics so you can deliver first-in-market IoT solutions.

Intel® Solutions Marketplace is a searchable directory where you can find ready-to-run solutions and connect with Intel partners that can help you develop your IoT products.

Simplify development

Save time and streamline your IoT and edge AI development with our open source toolkits, production-quality software and online prototyping sandboxes.

Intel® DevCloud for the Edge gives you online access to physical clusters of the latest Intel® hardware, plus a ready-to-run installation of the Intel® Distribution of OpenVINO™ toolkit with reference implementations and pretrained module. Use it to develop and test your own computer vision applications, compare hardware performance, and choose the right platforms for your applications.

Intel® Edge Software Hub is a one-stop resource for edge computing software that provides production-quality software data and image processing, edge AI analytics, and computer vision applications.

Intel® Developer Zone for IoT brings together training materials, software tools, and development kits that can help you build, optimize, and deploy your IoT solutions.

More performance, more capabilities for IoT

UP TO **1.7X**
improvement in
**SINGLE-THREAD
PERFORMANCE**
gen over gen[4]

UP TO **1.5X**
improvement in
**MULTI-THREAD
PERFORMANCE**
gen over gen[4]

UP TO **2X**
performance
improvement in
GRAPHICS
gen over gen[4]

Integrated
FUNCTIONAL SAFETY
and **REAL-TIME
COMPUTING**[1,2]

OUT-OF-BAND and IN-BAND
**Remote
Management**

See backup for configuration details for more complete information about performance and benchmark results, visit www.intel.com/benchmarks.
4. Source: Intel. Claims based on a) SPEC CPU 2006 metric estimates based on Pre-Si projections and b) 3DMark11 estimates based on Pre-Si projections, using Intel® Pentium® J4205 as prior generation.

KEY FEATURES[5]

Performance

- **More choices for IoT:** Two- and four-core options ranging from 1.0 GHz to 1.9 GHz (high-frequency mode) with burst frequencies up to 3.0 GHz

- **Room for faster RAM:** 4x32 LPDDR4/x @4267 MT/s, max (8 GB, 16 GB, @3200 MT/s; 2x64 DDR4 @3200 MT/s, max 32 GB

- **Error correction with standard RAM:** In-band error-correcting code (IBECC) corrects single-bit memory errors in standard, non-ECC memory

- **Rich, 4K graphics:** Intel UHD Graphics drives up to three independent 4Kp60 displays via DisplayPort 1.3 and HDMI 2.0b

- **Improved GPU performance for AI and computer vision:** Up to 32 execution unit (EU) cores can double as deep learning inference and computer vision engines

Hardware-based security

- **Intel® Platform Trust Technology (Intel® PTT):** Provides integrated TPM 2.0 capability, reducing bill of materials cost and board area.

- **Intel® AES New Instructions (Intel® AES-NI), Intel® SHA Extensions, Intel® Secure Key:** Supports hardware-accelerated cryptography operations without compromising on productivity.

- **Intel® Boot Guard:** Mitigates against platform tampering using hardware root of trust.

Integrated IoT-specific services

- **Dedicated ARM offload engine for IoT workloads:** The Intel PSE uses an ARM microcontroller with dedicated hardware resources for real-time computing, network synchronization, and low-DMIPS computing. The Intel PSE can also host functions like out-of-band management and network proxies.

- **Integrated, real-time computing:** Intel TCC and TSN support worst-case execution time (WCET) and ultra-reliable low-latency communication (URLLC) at the device level and across networks of devices.

- **Certified[8] for FuSa:** Intel Atom x6427FE and x6200FE processors meet IEC 61508 and ISO 13849 requirements for functional safety and safety integrity levels (SIL2/Cat.3 PL d certified[8], SIL3/Cat.4 PL e capable).

- **Intel Safety Island:** Integrated, functional safety IP works with the CPU to check for errors, flag and report faults, and orchestrate diagnostic tests (available on Intel Atom x6427FE and x6200FE processors).

- **Remote device management:** Monitor and manage devices using OOB (through wired Ethernet) capability when the OS is unresponsive and INB management (through Wi-Fi or wired Ethernet) to perform remote firmware and software updates.

Connectivity

- **Integrated Ethernet:** 3x 2.5GbE time-sensitive networking–enabled MACs

- **High-speed lanes:** Eight lanes/six ports PCIe 3.0, up to four USB 3.1 ports, and 10 USB 2.0 ports

Reference platform

Intel Atom x6000E Series and Intel Pentium and Intel Celeron N and J Series Processors[5]
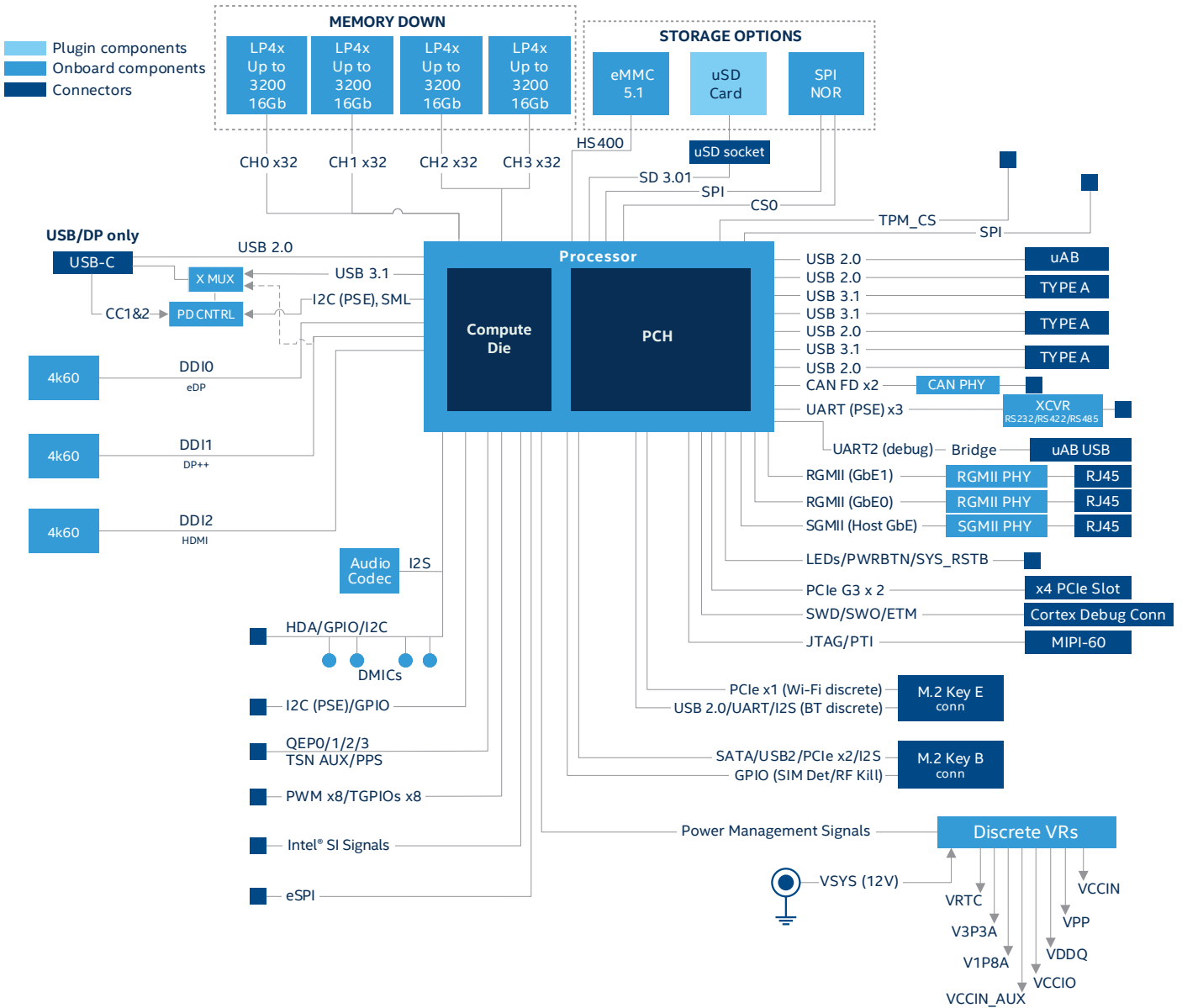
PLATFORM LINEUP

Processor	Cores	Cache	CPU High-Frequency Mode	CPU Burst (Turbo) Mode	Graphics High-Frequency Mode	Graphics Burst (Turbo) Mode	Max TDP	In-Band ECC	Intel® Time Coordinated Computing	Intel® Safety Island	Package
Intel® Celeron® Processor J6413	4	1.5 MB	1.8 GHz	3.0 GHz	400 MHz	800 MHz	10W	No	No	No	FCBGA1493
Intel® Pentium® Processor J6425	4	1.5 MB	1.8 GHz	3.0 GHz	400 MHz	850 MHz	10W	No	No	No	FCBGA1493
Intel® Celeron® Processor N6211	2	1.5 MB	1.2 GHz	3.0 GHz	250 MHz	750 MHz	6.5W	No	No	No	FCBGA1493
Intel® Pentium® Processor N6415	4	1.5 MB	1.2 GHz	3.0 GHz	350 MHz	800 MHz	6.5W	No	No	No	FCBGA1493
Intel Atom® x6211E Processor	2	1.5 MB	1.2 GHz	3.0 GHz	350 MHz	750 MHZ	6W	Yes	No	No	FCBGA1493
Intel Atom® x6413E Processor	4	1.5 MB	1.5 GHz	3.0 GHz	500 MHz	750 MHZ	9W	Yes	No	No	FCBGA1493
Intel Atom® x6425E Processor	4	1.5 MB	1.8 GHz	3.0 GHz	500 MHz	750 MHZ	12W	Yes	No	No	FCBGA1493
Intel Atom® x6212RE Processor	2	1.5 MB	1.2 GHz	N/A	350 MHz	N/A	6W	Yes	Yes	No	FCBGA1493
Intel Atom® x6414RE Processor	4	1.5 MB	1.5 GHz	N/A	400 MHz	N/A	9W	Yes	Yes	No	FCBGA1493
Intel Atom® x6425RE Processor	4	1.5 MB	1.9 GHz	N/A	400 MHz	N/A	12W	Yes	Yes	No	FCBGA1493
Intel Atom® x6427FE Processor	4	1.5 MB	1.9 GHz	N/A	400 MHz	N/A	12W	Yes	Yes	Yes	FCBGA1493
Intel Atom® x6200FE Processor	2	1.5 MB	1.0 GHz	N/A	N/A	N/A	4.5W	Yes	Yes	Yes	FCBGA1493

SOFTWARE OVERVIEW

Enhanced for IoT, Intel Atom® x6000E Series and Intel® Pentium® and Celeron® N and J Series Processors support these operating systems, bootloaders, and SDKs.[6]

Category	Operating systems, boot loaders, and SDKs	Implementation	Distribution and Support
Operating Systems[4]	Windows 10 IoT Enterprise (64-bit)	Intel	Intel, Microsoft
	Yocto Project BSP tool-based embedded Linux distribution (64-bit)	Intel	Intel, Yocto Project community, ISV partners
	Linux Ubuntu (64-bit)	Canonical Ltd.	Canonical Ltd.
	Wind River Linux LTS distribution (64-bit)	Wind River	Wind River
	Android 10 (64-bit)[7]	Intel	ISV partners
Boot firmware	UEFI/BIOS	IBVs	IBVs
	Intel® Slim Bootloader	Intel	Bootloader ecosystem and open source community
	coreboot	Intel	Bootloader ecosystem and open source community
Intel® Programmable Services Engine	Intel® Programmable Services Engine firmware (Zephyr RTOS–based)	Intel	Zephyr RTOS ecosystem and open source community
SDK	Intel® Media SDK	Intel	Intel
	Intel® Distribution of OpenVINO™ toolkit	Intel	Intel
	Intel® System Studio	Intel	Intel
	Intel® Context Sensing SDK	Intel	Intel
	Intel® Time Coordinated Computing and time-sensitive networking software toolkit	Intel	Intel

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To learn more, visit intel.com/content/www/us/en/design/products-and-solutions/processors-and-chipsets/elkhart-lake/overview.html.

1. Not all SKUs include the Intel® Safety Island or support functional safety.
2. Not all SKUs support real-time computing, time-sensitive computing, or time-synchronous networking.
3. Source: IDC FutureScape, Worldwide Internet of Things 2020 Predictions.
4. Source: Intel. Claims based on a) SPEC CPU 2006 metric estimates based on Pre-Si projections and b) 3DMark11 estimates based on Pre-Si projections, using Intel® Pentium® J4205 as prior generation.
   Configurations:
   Performance results are based on projections as of September 1, 2020
   Processor: Intel® Pentium® J6425 PL1=10W TDP, 4C4T Turbo up to 3.0 GHz
   Graphics: Intel Graphics Gen 11 gfx
   Memory: 16GB LPDDR4-3200
   OS: Windows 10 Pro
   Compiler version: IC18
   Processor: Intel® Pentium® J4205 PL1=10W TDP, 4C4T Turbo up to 2.6 GHz
   Graphics: Intel Graphics Gen 9 gfx
   Memory: 16GB LPDDR4-2400
   OS: Windows 10 Pro
   Compiler version: IC18
   Performance numbers are Pre-Si projections and are subject to change. Results reported may need to be revised as additional testing is conducted. The results depend on the specific platform configurations and workloads utilized in the testing, and may not be applicable to any particular users components, computer system or workloads. The results are not necessarily representative of other benchmarks.
5. Not all SKUs include every feature.
6. Not all features are supported in every operating system.
7. Android 10 (64-bit) availability to be determined.
8. Certification in process.

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Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

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Not all features are available on all SKUs.

Not all features are supported in every operating system.

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