

# PRODUCT BRIEF

Intel IoT Technology  
Intel Atom®, Intel® Pentium®, and Intel® Celeron® Processors



## Achieving New Levels of CPU Performance, Fast Graphics and Media Processing, Image Processing, and Security

The latest generation of Intel Atom®, Pentium®, and Celeron® processors empowers real-time computing in digital surveillance, new in-vehicle experiences, advancements in industrial and office automation, new solutions for retail and medical, and more.



### Meeting the demands of the rapidly growing Internet of Things

The number of connected machines has grown by approximately 300 percent<sup>1</sup> in recent years and is expected to continue to explode. By 2020, 330 billion devices will create 35 trillion GB of data annually,<sup>2</sup> and will require greatly increased processing power at the edge in order to maintain viability. Intel is supporting this rapid development and the growing complexity of IoT infrastructures with the release of the Intel Atom® processor E3900 series, Intel® Pentium® processor N4200, and Intel® Celeron® processor N3350. They deliver the ability to handle more tasks. From manufacturing machines that can see, to intelligent video systems that can analyze data, these processors enable amazing new possibilities.

### Powerful edge intelligence for IoT

These Intel Atom, Pentium, and Celeron processors offer enhanced processing power in compact, low-power packages. They are now available with a dual- or quad-core processor running at up to 2.5 GHz and memory speeds up to LPDDR4 2400. All of this performance resides in a compact flip chip ball grid array (FCBGA), utilizing 14 nm silicon technology, making it an excellent fit for a wide range of IoT applications when space and power are at a premium.

### Compact graphics powerhouse

On top of enhanced compute power, these processors offer intense media processing capability. With the latest Intel® graphics processor integrated, these processors also deliver greatly increased video encode and playback performance. This means each processor can operate three independent displays: a single internal display, and dual external displays, at a resolution of 4096 x 2160 for DisplayPort\* displays and 3840 x 2160 for HDMI and eDP\* displays—more than four times the resolution of standard HD. The Intel Atom processor 3900 series also offers exceptional efficiency with real-time video analytics at the edge for developers using the [Intel® SDK for OpenCL™ applications](#) and the Intel® Computer Vision SDK. This powerful new media capability in a flexible package opens new opportunities for those creating systems for media-rich applications.

### The next level of determinism

The ability to synchronize the operations of automated machines is key to making IoT processes more reliable and paving the way for new, more demanding applications. Intel® Time Coordinated Computing Technology (Intel® TCC Technology) can synchronize networks of devices, greatly improving real-time deterministic behavior within the system.

## Enhanced, silicon-level security

Protecting your IoT operations from unwanted access is always a key consideration. The Intel Atom, Pentium, and Celeron processors offer hardened, more capable security at nearly every level. They can enhance your existing security solutions and make new types of protection possible. With the new Intel® Trusted Execution Engine (Intel® TXE), they offer enhanced data and operations protection in the most challenging environments, from retail transactions to manufacturing floors. This deep layer of protection can keep select data away from hackers, even if the OS is compromised. This security is matched with fast cryptographic execution based on Intel® AES New Instructions (Intel® SHA-NI, RDRAND), and a number of secure boot features, such as Intel® Boot Guard 2.0.

## Enhanced reliability

The Intel Atom processor offers dependable performance even in extreme circumstances, such as in the industrial and aerospace environments. Dual-channel error correction code (ECC) is now available when using DDR3L and helps guard against single-bit memory errors that can corrupt a system and lead to a crash. These processors are also available with

an extreme junction temperature range of -40°C to 110°C. What's more, processors that are qualified and developed for operation in automotive applications, like in-vehicle infotainment (IVI) systems and digital cluster systems, are also available.

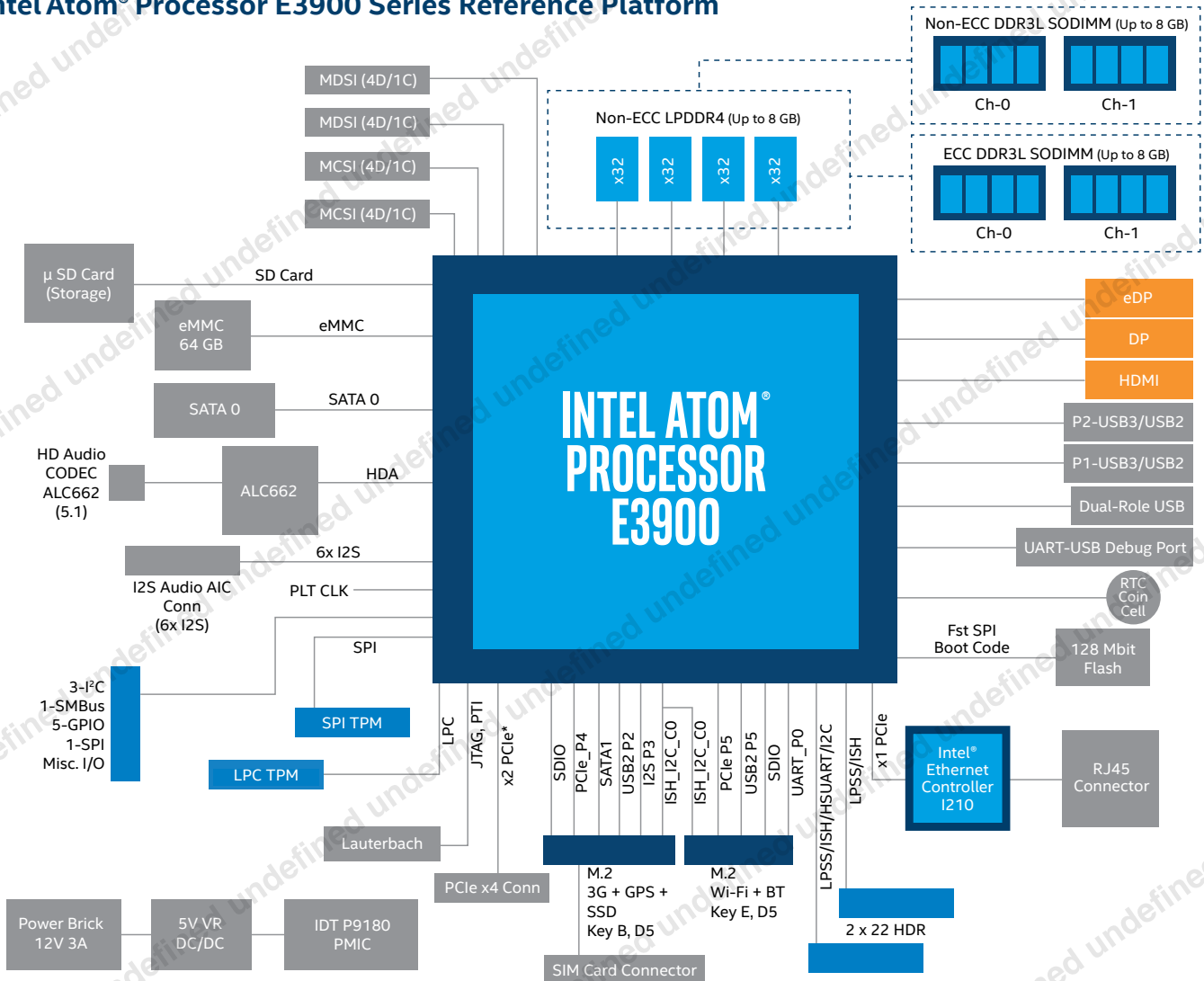
## Multiple outstanding MMIO on APL-I

APL-I introduces support for multiple outstanding memory Mapped I/O (MMIO) transactions. This feature provides performance isolation benefits by eliminating architectural bottlenecks previously associated with MMIO read transactions. This is a foundational requirement of workload consolidation, enabling applications on separate cores to independently access I/O devices.

## More I/Os

These versions of the Intel Atom, Pentium, and Celeron processors help make IoT solutions less complex to build and enable a more engaging experience. With an expanded number of I/Os, complex configurations can be enabled while requiring fewer external hubs. These new I/Os include six USB 3.0 ports and four PCIe\* ports (six lanes) for greatly expanded, high-speed connectivity.

## Intel Atom® Processor E3900 Series Reference Platform



## KEY FEATURES

### INTEL COMPUTE POWER

**Faster Memory Speeds:** Get up to 8 GB of LPDDR4.

**More Processing Power:** These Intel Atom®, Pentium®, and Celeron® processors are available with up to quad-core, 14 nm processors running at up to 2.5 GHz.

**Compact Package:** The low-power FCBGA package allows it be deployed in a wide range of applications.

### POWERFUL MEDIA PERFORMANCE AND IMMERSIVE 3D GRAPHICS

**Enhanced Display Performance:** Get support for Ultra HD 4K at 60 Hz on three independent displays via three simultaneous graphics pipes.

**Higher Resolution:** Capture 13MP stills and 1080p60 video.

**Enhanced API Support:** Take advantage of the latest media hardware acceleration, including Intel® Media SDK (Intel® Quick Sync Video), Intel® Computer Vision SDK, DirectX® 12, and OpenGL® 4.3.

**Powerful Video Analytics:** Up to 15 simultaneous 1080p30 decode streams deliver high-level performance for surveillance and other videocentric applications.

### THE NEXT LEVEL OF DETERMINISM

**Intel® Time Coordinated Computing Technology (Intel® TCC Technology):** Available when using Linux®, Intel TCC Technology coordinates and synchronizes peripherals and networks of connected devices, achieving improved determinism. It can resolve latency issues in applications, such as robotics manufacturing, by synchronizing the clocks of robotic devices to coordinate actions across networks.

### RELIABLE AND EFFICIENT COMPUTING

**Error Correction Code (ECC):** Delivers enhanced system reliability by helping to detect and eliminate DDR3L memory errors.

**High-Temperature Rating:** Available SKUs offer -40°C to 110°C junction temperature to support applications in extreme environments.

**Extended Reliability:** Protect your investment in industrial and automotive environments.

**Automotive-Qualified:** Select SKUs offer the durability that qualifies them for automotive applications.

### MORE I/Os

**More I/O Ports:** More USB ports, PCIe® lanes, and other ports allow for more complex configurations with fewer hubs.

**High-Speed Connectivity:** Six USB 3.0 ports and four PCIe ports with six lanes allow for ultrahigh data transfer rates with a greatly expanded number of peripherals.

## SECURITY FEATURES OF THE INTEL ATOM® PROCESSOR E3900 SERIES

### FEATURES OF THE NEW INTEL® TRUSTED EXECUTION ENGINE 3.0 (INTEL® TXE 3.0) DEDICATED SECURITY COPROCESSOR

**Secure Boot or Measured Boot:** Prevents malware and other unauthorized software from replacing or tampering with the low-level firmware and OS.

**Digital Rights Management (DRM), HDCP 1.4 Wired/HDCP 2.2 Wireless, Protected Audio Video Path (PAVP):** Receive, process, and transmit premium content securely.

**Intel® Platform Trust Technology on Linux® OS:** Stores secrets in hardware and performs crypto operations compliant to full Trusted Computing Group Trusted Platform Module® 2.0 specification.

### ENHANCED CPU CRYPTOGRAPHY FEATURES

**Intel® AES-NI, SHA-NI, RDRAND:** Enables data privacy and integrity at higher throughput using native CPU instructions. For example, whole disk encryption, data at rest, and data in transit.

## INTEL ATOM®, INTEL® PENTIUM®, AND INTEL® CELERON® PROCESSORS FOR IOT

PROCESSOR NUMBER	CPU CORES	CPU HFV FREQUENCY	CPU SINGLE-CORE BURST FREQUENCY	CPU L2 CACHE SIZE	THERMAL DESIGN POWER	PACKAGE
Intel® Celeron® Processor N3350	2	1.1 GHz	2.4 GHz	2 MB	6W	FCBGA1296
Intel® Pentium® Processor N4200	4	1.1 GHz	2.5 GHz	2 MB	6W	FCBGA1296
Intel Atom® x5-E3930 Processor	2	1.3 GHz	1.8 GHz	2 MB	6.5W	FCBGA1296
Intel Atom® x5-E3940 Processor	4	1.6 GHz	1.8 GHz	2 MB	9.5W	FCBGA1296
Intel Atom® x7-E3950 Processor	4	1.6 GHz	2.0 GHz	2 MB	12W	FCBGA1296

## SUPPORTED SOFTWARE

OS VENDOR	OPERATING SYSTEM (FUTURE SUPPORT PLANNED)	IMPLEMENTATION	DISTRIBUTION AND SUPPORT
Microsoft	Windows* 10 Enterprise (64-bit), IoT Core (32/64-bit)	Intel	Intel, Microsoft
Linux*	Wind River 8 Linux distribution (64-bit)	Wind River	Wind River
	Yocto Project* BSP tool-based embedded Linux distribution (64-bit)	Intel	Yocto Project and ISV Partners
Android*	Android (64-bit) Marshmallow PV April 17, Android O ETA target Q2 '18	Intel	ISV Partners
RTOS	Wind River VxWorks* 7	Wind River	Wind River

### Sources for BIOS delivery

- American Megatrends
- Insyde Software
- Phoenix Technologies
- Byosoft

### Sources for boot-loader support based on Intel® Firmware Support Package (Intel® FSP)

- Wind River
- American Megatrends
- Insyde Software
- Waris
- Ircona
- Eltan
- Byosoft
- Archermind
- SysPro Consulting



Learn more about these new features and capabilities at [intel.com/content/www/us/en/embedded/products/apollo-lake/overview.html](https://intel.com/content/www/us/en/embedded/products/apollo-lake/overview.html).

1. McKinsey & Company, May 2013.

2. "Big Data, Small Footprint": <http://www.bestcomputerscienceschools.net/big-data/>.

Estimated results were obtained prior to implementation of recent software patches and firmware updates intended to address exploits referred to as "Spectre" and "Meltdown". Implementation of these updates may make these results inapplicable to your device or system.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more information go to [intel.com/benchmarks](https://intel.com/benchmarks).

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