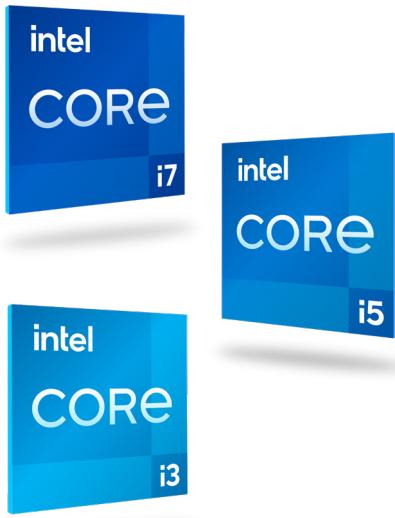


# Meet your most rigorous IoT demands with processors enhanced for IoT

## Transforming business and society with "enhanced for IoT" processing on the edge



The Internet of Things (IoT) will be the largest revolution in the data economy. By 2025, 55.6% of all data will come from IoT devices, such as retail devices, industrial equipment, digital signage, medical implants, and other connected things.<sup>1</sup> To address this new IoT-enabled future, we developed the "enhanced for IoT" 11th Gen Intel® Core™ processors.

Specifically for IoT markets, we further enhanced our hardware with features such as time-coordinated computing, functional safety design elements, extended temperature for cold and harsh environments, and long product availability on selected SKUs. When your business is powered by Intel® technologies that have been enhanced specifically for IoT, you'll get optimized performance at every point, practical ways to use artificial intelligence, broad connectivity support, and a built-in foundation of security to help protect your data and systems. With scalable and intelligent technologies from Intel, you can harness the true potential of your business.

### Power and capabilities you need for demanding IoT applications

IoT spans a huge array of devices, technologies, and applications — from digital signage in sync with the cloud to embedded systems that execute on their own, and real-time, deterministic, industrial controls.

11th Gen Intel® Core™ processors deliver high-performance CPU/GPU compute with integrated AI acceleration, plus capabilities for applications that demand high-speed processing, computer vision, and low-latency deterministic computing. They deliver a balance of performance (up to a 23% gain in single-thread performance, and up to a 19% gain in multi-thread performance vs. 8th Gen Intel® Core™ processors\*) and responsiveness in a low-power platform built on our third-generation 10 nm process technology, while offering Intel® Iris® Xe graphics, PCI Express 4.0, and Thunderbolt™ 4/USB4.<sup>2</sup>

Up to 96 execution units that will deliver up to 2.95x the graphics performance of 8th Gen Intel® Core™ processors\* and dual video decode boxes (which can handle up to 40 simultaneous 1080p streams at 30 frames per second) drive up to four independent 4K HDR displays or two 8K SDR outputs. The platform also delivers AI via Intel® Deep Learning Boost capabilities through both the CPU and integrated GPU.<sup>2</sup>

For demanding IoT applications like robotics or transportation control, the platform supports extensive virtualization, in-band error correction, and Intel® Time Coordinated Computing (Intel® TCC) to minimize jitter and meet the demands of critical, real-time computing applications. As an orchestrated system, the 11th Gen Intel® Core™ processor maximizes its hardware resources efficiently and effectively for truly breakthrough performance.

See backup for configuration details. For more complete information about performance and benchmark results, visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

Not all features available on every SKU. See product lineup for more details.

High-performance, responsive CPU/GPU compute combined with AI/deep learning capabilities in a low-power platform

### Raise performance across the board

Built on our third-generation, 10 nm microarchitecture, 11th Gen Intel® Core™ processors post up to a 23% gain in single-thread performance, up to a 19% gain in multi-thread performance and up to 2.95x the graphics performance vs. 8th Gen Intel® Core™ processors.<sup>2</sup>

### Handle multiple Real-time workloads with minimal jitter

The combination of the 11th Gen Intel® Core™ processor and Intel® Iris® Xe graphics performance are complemented with hardware-based acceleration and virtualization to handle multiple IoT-specific tasks simultaneously. As an orchestrated system, it maximizes hardware resources efficiently for real-time, multiworkload performance with minimal jitter.

### Bring functional safety solutions to market faster\*

Intel® Functional Safety Essential Design Package (Intel® FSEDP) provides technical documentation to speed development and certification of mission-critical platforms that must comply with functional safety standards.

### Put accelerated AI inferencing and computer vision to work

11th Gen Intel® Core™ processors deliver accelerated AI inferencing and computer vision in parallel with other core functions. AI and deep-learning inferencing can run on up to 96 graphic execution units (8-bit integer = INT8) or run on the CPU with Vector Neural Network Instructions (VNNI), which condenses three Advanced Vector Extensions (AVX) instructions into one.

### Stream, process and analyze video channels simultaneously

11th Gen Intel® Core™ processors include Intel® Iris® Xe graphics with up to 96 execution units. The platform includes dual video decode boxes that can:

- Process up to 40 simultaneous streams of 1080p 30 fps video
- Output up to four channels of 4K or two channels of 8K video

### Consolidate multiple workloads onto a single CPU

11th Gen Intel® Core™ processors are ideal for converging edge applications that would normally require multiple dedicated CPUs, GPUs, and accelerators. A single 11th Gen Intel® Core™ processor can handle any of these workloads with minimal power consumption:

- Synchronous, deterministic control systems
- Vision systems with AI capabilities
- Interactive white boards and digital signage

### Help defend vulnerable IoT devices against attack

Embedded devices and industrial controls are vulnerable on multiple fronts. Hackers can exploit hardware and network weaknesses. Intel provides security at the platform boot level, security for data at rest on the platform and security for data in-flight. New Security features like Intel® Total Memory Encryption complement capabilities like Intel® Boot Guard.

### Build on a solid foundation

11th Gen Intel® Core™ processors come in two classes – embedded and industrial – to provide a solid foundation for durable, long-life equipment.

<sup>2</sup>See backup for configuration details. For more complete information about performance and benchmark results, visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

\*Not all features are available on every SKU. See product lineup for more details.


**KEY FEATURES**

## Performance

- Third-generation, Intel® 10 nm microarchitecture, up to four processing cores, up to 96 graphics execution units
- Supports DDR4 and LPDDR4x, with optional In-Band ECC
- Configurable 12/15/28 watt thermal design points, in a single SKU

## Intel® Iris® Xe graphics

- Up to 96 graphics execution units, four independent display pipes, capable of up to two channels of 8K60 or four channels of 4K60
- Up to two VDBoxes process up to 40 1080p 30 fps video streams

## Real-Time computing (on select SKUs)\*

- Hardware-assisted virtualization keeps performance stable as workloads grow
- Intel® Time Coordinated Computing technology and Time-Sensitive Networking reduce latency and minimize jitter for synchronous process control and real-time computing
- In-band error correction code provides Single Error Correction, Double Error Detection at a 64-byte cache-line level

## Accelerated AI and computer vision

- Intel® Deep Learning Boost improves inferencing performance with new Vector Neural Network instructions on the CPU, which combine three instructions into one
- Inferencing applications can also take advantage of up to 96EU on the GPU to run 8-bit integer algorithms
- Pairs with Intel® Movidius™ VPUs for additional inferencing capabilities

## High-speed connectivity

- Integrated MACs to support one 1GbE port, plus one 2.5GbE port with Time-Sensitive Networking (on select SKUs)
- Gigabit (1.73 Gbps) Wi-Fi, Bluetooth 5
- Discrete 2.5GbE MAC/PHY LAN, Intel® Ethernet Controller I225LM/IT (code name Foxville)
- Four Thunderbolt™ 4/USB4 ports
- Four PCIe 4.0 lanes and 12 PCIe 3.0 lanes

## Hardware-based security and device management

- Total memory encryption helps protect against cold-boot attacks
- Key locker helps protect encrypted keys and decrypt/encrypt operations

## Supports commercial and open source operating systems

- Windows 10 IoT Enterprise LTSC, Linux Kernel LTS, VxWorks, Android
- Hypervisors with improved Real Time performance: KVM and RTS
- Slim Bootloader

## Streamlined Intel development environment

- Intel® System Studio, Intel® Distribution of OpenVINO™ toolkit, Intel® Media SDK, Intel® Time Coordinated Computing software toolkit, and Intel® Context Sensing SDK

 **USE CASES**

11th Gen Intel® Core™ processors are high-performance, low-power CPUs designed for commercial and industrial applications. The platform's combination of speed, high-powered Intel® Iris® Xe graphics and AI acceleration, and hardware support for real-time computing makes it ideal for critical applications that demand high-performance vision systems, deep learning capabilities, serious processing power, and/or deterministic computing.

### Industrial sectors: Build mission-critical control systems

Bring multiple IoT devices and sensors together in a synchronous system that performs as a single machine that can meet real-time computing demands.

- Orchestrate and prioritize multiple workloads, robots, logic controllers, or transportation control systems
- Take advantage of optimized computer vision/AI inferencing performance
- Manage smart, multiaxis, autonomous robots
- Build software-defined multifunction control systems that meet real-time performance requirements

### Retail, banking, and hospitality: Drive intelligent, immersive digital signage, automate checkout, and fight fraud

- Powerful 3D, multiple-display signage, and video experiences
- Integrate facial, speech, and fingerprint recognition at ATMs and teller windows
- Support core POS computer vision/AI-powered loss prevention and fraud detection at self-checkout kiosks

### Healthcare: Build next-generation medical imaging devices with high-resolution displays and AI-powered diagnostics

Give medical professionals a sharper view of medical images and more perceptive, more precise diagnostic assistance

- Support up to four 4K HDR displays or two 8K SDR resolution
- Process images faster with next-generation CPU and GPU architectures
- Increase diagnostic capacity with computer vision and AI acceleration

### Public safety: Create smarter, faster security systems

- Build smart network video recorders with onboard AI inferencing and analytics
- Support advanced object recognition
- Capture and analyze video, audio, and metadata for retail, security, and public safety

### Get to market faster with help from Intel partner programs

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.

[Intel® AI: In Production](#) is our partner program for computer vision and edge AI equipment providers, system integrators, software providers, and solution aggregators/distributors who can help you integrate scalable AI solutions into your IoT platforms.

## SOFTWARE OVERVIEW

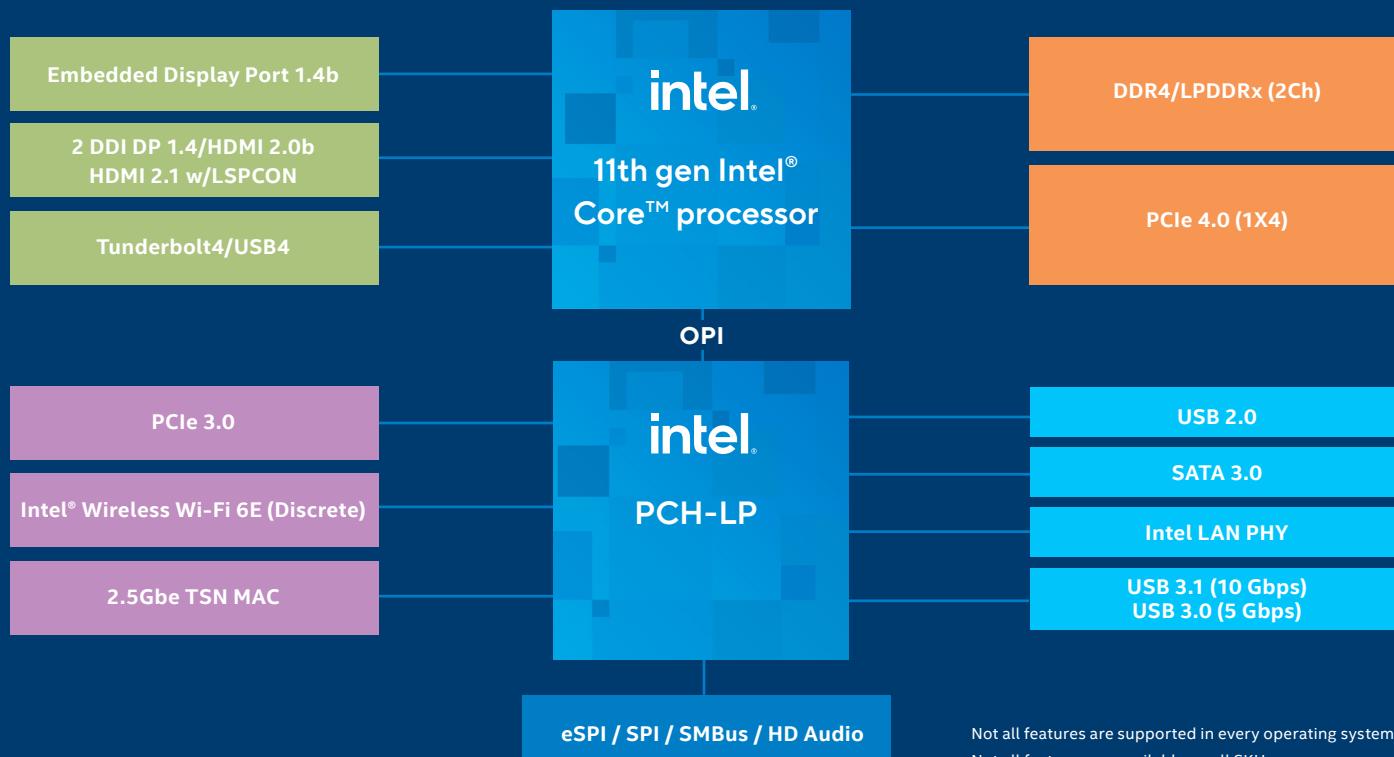
### 11th Gen Intel® Core™ processor

Licensing Model	Operating Systems/Hypervisor	Distributor and Support
Commercial	Windows 10 IOT Enterprise (64-bit) LTSC RS5	Microsoft
	Ubuntu Linux	Canonical
	Redhat Linux	Redhat
	Wind River VxWorks RTOS	Wind River
	Real Time System (Type 1 Hypervisor)	Real Time Systems
Open Source	Linux LTS Kernel with Preempt RT Patch	Linux Community (kernel.org) Intel Open Source (01.org)
	Virtualization: KVM (Type 2 Hypervisor), ACRN (Post Launch)	
	Android (post launch)	
	BIOS Vendors: American Megatrends, Thundersoft, Byosoft, Insyde, Phoenix	

Not all features are supported in every operating system. Refer to [Intel IoT Solutions Alliance](#) for partner contact information.

## BLOCK DIAGRAM

High-performing and low-power 11th Gen Intel® Core™ processor-based platform with IoT-centric features.



Not all features are supported in every operating system.  
Not all features are available on all SKUs.

## PLATFORM LINE UP

## 11th Gen Intel® Core™ Processors – General Embedded

Brand	Processor Number / MM# /Forecast Name	TDP / cTDP	Cores	Threads	Cache	BaseFreq @ TDP/ cTDP	MaxTurbo Freq	Graphics/Media/ Display	InBand ECC	Other	Temp Range
Intel® Core™ i7 Processor	i7-1185G7E MM# 99A3LH FH8069004541800	28W/ 15W/ 12W	4	8	12MB	2.8 GHz/ 1.8 GHz / 1.2GHz	4.4 GHZ	Intel® Iris® Xe graphics 96 EU 4x4k or 2x8k Displays 2 VDBOX	No	12 HSIO Lanes (PCH)	0C to +100C Tj
										x4 PCIe (CPU)	
										4x Thunderbolt4/ USB4	
Intel® Core™ i5 Processor	i5-1145G7E MM# 99A3LP FH8069004542000	28W/ 15W/ 12W	4	8	8 MB	2.6 GHz/ 1.5 GHz/ 1.1 GHz	4.1 GHZ	Intel® Iris® Xe graphics 80 EU 4x4k or 2x8k Displays 2 VDBOX	No	12 HSIO Lanes (PCH)	0C to +100C Tj
										x4 PCIe (CPU)	
										4x Thunderbolt4/ USB4	
Intel® Core™ i3 Processor	i3-1115G4E MM# 99A3M2 FH8069004542300	28W/ 15W/ 12W	2	4	6 MB	3.0 GHz/ 2.2 GHz/ 1.7 GHz	3.9 GHZ	Intel® HD graphics 48EU 4x4k or 1x8k Displays 1 VDBOX	No	12 HSIO Lanes (PCH)	0C to +100C Tj
										x4 PCIe (CPU)	
										4x Thunderbolt4/ USB4	

## 11th Gen Intel® Core™ Processors – Industrial

Brand	Processor Number / MM# /Forecast Name	TDP / cTDP	Cores	Threads	Cache	BaseFreq @ TDP/ cTDP	MaxTurbo Freq	Graphics/Media/ Display	InBand ECC	Other	Intel® FSEDP	Temp Range
Intel® Core™ i7 Processor	i7-1185GRE MM# 99A3LL FH8069004541900	28W/ 15W/ 12W	4	8	12MB	2.8 GHz/ 1.8 GHz / 1.2GHz	4.4 GHZ	Intel® Iris® Xe graphics 96 EU 4x4k or 2x8k Displays 2 VDBOX	Yes	12 HSIO Lanes (PCH)	Yes	-40C to +100C Tj
										x4 PCIe (CPU)		
										4x Thunderbolt4/ USB4		
										TCC/TSN		
Intel® Core™ i5 Processor	i5-1145GRE MM# 99A3LV FH8069004542100	28W/ 15W/ 12W	4	8	8 MB	2.6 GHz/ 1.5 GHz/ 1.1 GHz	4.1 GHZ	Intel® Iris® Xe graphics 80 EU 4x4k or 2x8k Displays 2 VDBOX	Yes	12 HSIO Lanes (PCH)	Yes	-40C to +100C Tj
										x4 PCIe (CPU)		
										4x Thunderbolt4/ USB4		
										TCC/TSN		
Intel® Core™ i3 Processor	i3-1115GRE MM# 99A3M9 FH8069004542400	28W/ 15W/ 12W	2	4	6 MB	3.0 GHz/ 2.2 GHz/ 1.7 GHz	3.9 GHZ	Intel® HD graphics 48EU 4x4k or 1x8k Displays 1 VDBOX	Yes	12 HSIO Lanes (PCH)	No	-40C to +100C Tj
										x4 PCIe (CPU)		
										4x Thunderbolt4/ USB4		
										TCC/TSN		

1. IDC white paper, sponsored by Seagate, Data Age 2025, April 2017.
2. Source: Intel. Performance claim based on SPEC CPU 2017 metrics estimated by measurements on Intel internal reference platforms completed on August 27, 2020. Graphics claim based on 3DMark11\_V1.0.4 Graphics Score estimated by measurements on Intel internal reference platforms on August 27, 2020.

**Testing Configuration:**

Processor: Intel® Core™ i7 1185G7E PL1=15W TDP, 4C8T Turbo up to 4.4GHz

Graphics: Intel Graphics Gen 12 gfx

Memory: 16GB DDR4-3200

Storage: Intel SSDPEKKW512GB (512 GB, PCI-E 3.0 x4)

OS: Windows® 10 Pro (x64) Build 19041.331 (2004/ May 2020 Update). Power policy set to AC/Balanced mode for all benchmarks. All benchmarks run in Admin mode & Tamper Protection Disabled / Defender Disabled.

Bios: Intel Corporation TGLSWFI1.R00.3333.A00.2008122042OneBKC: tgl\_b2b0\_up3\_pv\_up4\_qs\_ifwi\_2020\_ww32\_4\_01

Processor: Intel® Core™ i7 – 8665UE 15W PL1=15W TDP, 4C8T Turbo up to 4.4GHz

Graphics: Intel Graphics Gen 9 gfx

Memory: 16GB DDR4-2400

Storage: Intel SSD 545S (512GB)

OS: Windows® 10 Enterprise (x64) Build 18362.175 (1903/ May 2019 Update). Power policy set to AC/Balanced mode for all benchmarks. All benchmarks run in Admin mode & Tamper Protection Disabled / Defender Disabled.

Bios: CNLSFWR1.R00.X208.B00.1905301319

**Notices & Disclaimers**

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 complete information, visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

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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for more information.

Results have been estimated or simulated.

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Not all features are available on all SKUs.

Not all features are supported in every operating system.

Intel may change availability of products and support at any time without notice.

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