

# Intel® AI POS Solutions Help Unlock the Value of Retail Data & Accelerate Smart Retail Development

The Intel logo is displayed in a white square box. It consists of the word "intel" in a lowercase, blue, sans-serif font, with a registered trademark symbol (®) to its upper right. The background of the entire image is a blurred photograph of a retail counter. In the foreground, a hand is holding a smartphone over a grey point-of-sale (POS) terminal. The terminal's screen shows a payment amount of "22.00 HKD" and the text "Present card". The terminal has a numeric keypad and buttons for "Clear" and "Enter". To the left, a portion of a red card reader is visible. The background shows a blurred display of goods, likely in a grocery or convenience store.



## Overview

With the rising labor costs in the retail industry and higher efficiency demands from consumers in the retail business, a growing number of enterprises are looking to integrate artificial intelligence (AI) technology into their POS systems to support applications such as smart product identification, automatic weight and price calculation, and smart anti-theft and loss prevention to enhance the efficiency of key operations such as checkout, improve the consumer experience, and save labor and price tag costs. At the same time, however, there are extensive challenges with smart POS systems in terms of computing power and algorithms, which affects retailers' confidence in smart POS systems.

Intel has partnered with original equipment manufacturers (OEMs) such as Qingdao HICS Intelligent Commercial System Co. Ltd (HICS) HICS, original design manufacturers (ODMs) such as Shenzhen GIFA Industrial Control Co., LTD (GIFA), and independent software vendors (ISVs) such as Shanghai Winmore Digital Technology Co., Ltd (Winmore Digit) to develop Intel® architecture-based AI POS solutions. The solution provides a reference design of smart POS from hardware to software to algorithm, featuring smart product identification and payment, the convergence of traditional and AI workloads, strong peripheral compatibility, support for Windows OS, easy integration, easy development, and easy maintenance to help retailers accelerate retail business operations, improve return on investment, and gain richer insights from data.

## Challenges: Smart POS faces Multiple Challenges of Computing Power, Algorithms, etc.

POS, as an important part of retail systems, provides efficient equipment support for applications such as merchandise payment and settlement. In addition to bank card payments, POS devices are increasingly incorporating features such as code-scanning payments to meet diverse payment needs, which is driving the growth of the POS market. The study shows that from 2020 to 2021, despite the impact of the COVID-19 pandemic, the POS industry saw a counter-trend growth driven by the replacement surge, with the number of connected POS units at 38,936,100 by the end of 2021, a significant increase from 30,892,800 at the end of 2019. The number of merchants connected to the interbank payment system grew from 23,629,600 to 27,982,700<sup>1</sup>.

In recent years, with the wide application of technologies such as AI, edge computing, IoT, and 5G, smart POS, which provides functions such as smart identification of products, consumption data collection, operation management, membership management, and financial services, has been developing rapidly. Not only does smart POS accelerate the efficient processing of products and bring unparalleled convenience to consumers' shopping, but it also helps innovative retail concepts such as unmanned retailing and borderless retailing to be implemented in practice, driving the retail industry to rapidly evolve into a new era. The report also forecasts a new round of growth for China's commercial POS industry as smart POS machines are being introduced. By 2027, the number of connected POS machines in China is expected to approach 69 million<sup>2</sup>.

One of the key technical hurdles in smart POS design is how to handle the corresponding loads such as AI inference more efficiently and make AI algorithms such as product recognition more accurate and applicable. The following challenges need to be addressed to achieve these goals:

**In terms of computing power**, the AI load integrated into the smart POS is mainly computer vision (CV) AI load, which requires model inference on the target image. For retail business efficiency, they usually expect inference speed to be guaranteed within a specific time frame, which places high demands on AI algorithms. Due to the cost-sensitive nature of the retail business, there are higher restrictions on hardware specifications and a preference for highly integrated, low-cost chips to meet arithmetic requirements. In addition, edge computing-based arithmetic solutions are also favored in terms of network stability and processing latency.

**In terms of algorithms**, AI algorithms in smart POS widely face challenges in terms of accuracy, robustness, and reinforcement training. For example, there are various kinds of products in the retail industry, especially non-standard products such as fresh food and bakery, which vary greatly in product form and color, and there may be problems such as some products cannot be accurately identified. Furthermore, in actual product recognition scenarios, factors such as lighting may have an impact on the accuracy of recognition. In addition, retailers will need to train models for new products to meet additional product recognition needs.

For cost savings and simplification of O&M, retailers also generally expect smart POS to integrate traditional loads with AI loads, enabling them to simultaneously handle enterprise resource planning (ERP), product management, security management, and other loads on a unified device, which requires targeted design and integration based on a high-performance, stable, and highly scalable hardware platform.

## Solution: Intel® AI POS Solution

Built on smart POS motherboards based on Intel® Core™ processors and Intel Atom® processors, the Intel® AI POS solution incorporates algorithms such as recognition of fresh foods, and software applications such as product management, and optimizes performance with Intel® OneAPI Toolkits and the Intel® Distribution of OpenVINO™ toolkit, thus providing a smart POS reference design with integrated hardware and software.

The Intel® AI POS solution adopts a modular software design for AI POS. The software reference architecture of the solution, as shown in Figure 1, includes modules of video processing, AI reasoning, ERP interfacing, UI interface, etc. It supports flexible model updates and replacements and can be easily interfaced with various mainstream ERP software to meet the needs of retail customers in payment management, operation management, control, and decision-making. In addition, the solution supports flexible AI triggers and allows retail customers to introduce AI capabilities in different processes according to business needs, enabling broader AI empowerment.

<sup>1,2</sup> Data from: Intelligence Research Group "China Mobile POS Industry Market Status Analysis and Future Prospect Planning Report", 2022-2028.

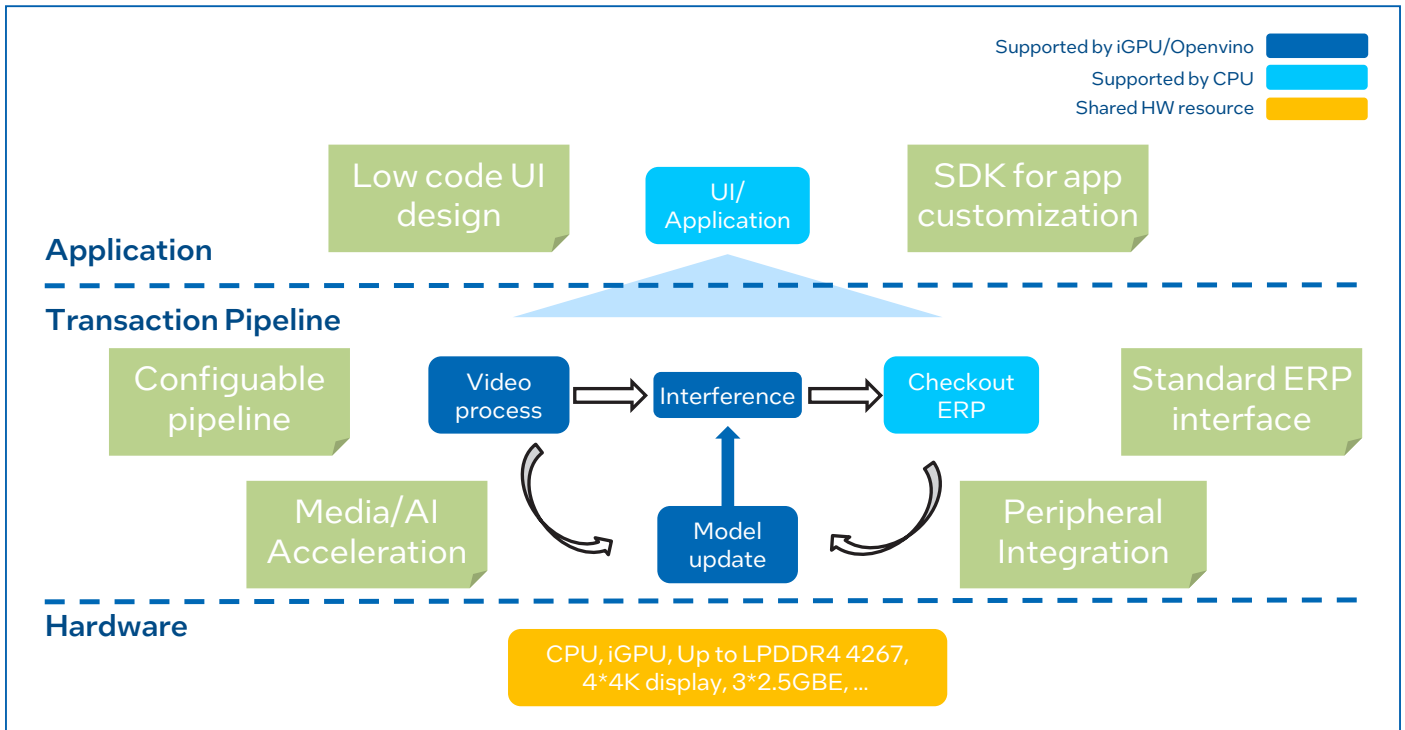


Figure 1. Intel® AI POS Solution Software Reference Architecture

The solution provides powerful AI, general-purpose CPU computing (computer vision, big data), and video capabilities, as well as frameworks for different scenarios. Depending on the different characteristics of the application load, the solution enables flexible allocation to employ CPU/iGPU to handle the load. Among them, the CPU is mainly used for processing general loads such as man-machine interfaces and software applications. iGPU can be used for processing AI loads, which can significantly enhance AI inference performance in combination with the OpenVINO™ Toolkit.

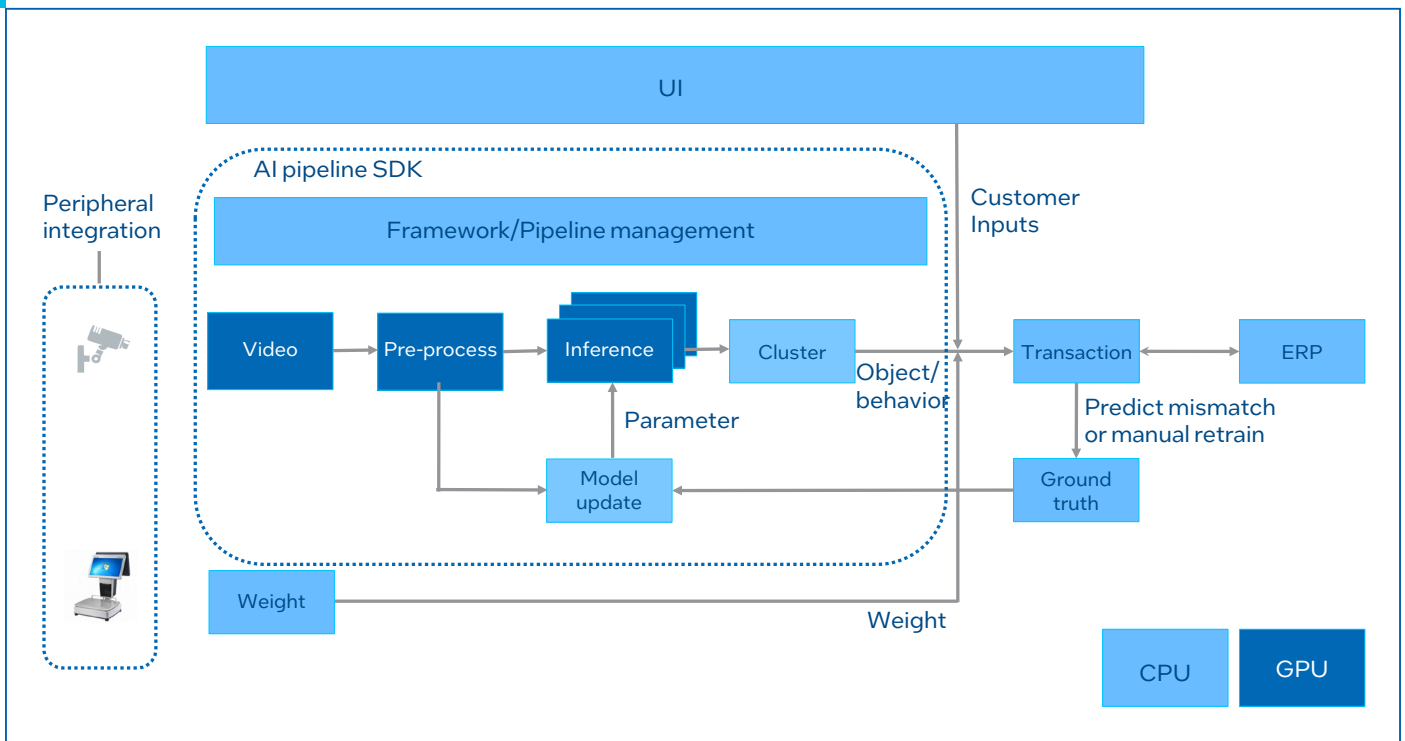


Figure 2. Intel® AI POS Solution Enables Flexible Invocation of CPU/iGPU Processing for Different Characteristics of Application Loads

CPUs and iGPUs of Intel® AI POS solutions are optimized for mathematical computation, video codecs, computer vision processing, and deep learning algorithms, which can accelerate cross-architecture and cross-platform migration of applications, reduce repetitive development efforts and save development costs with the unified software interface provided by Intel® OneAPI for computation, codecs, and computer vision processing.

Intel has partnered with OEMs, ODMs, ISVs, etc. to drive the scenario-based implementation and practice of Intel® AI POS solutions:

### ODM – Smart POS Mini Motherboard

The motherboard is the important basic hardware of smart POS equipment. To adapt to the special application environment of the smart POS, the smart POS motherboard is usually mainly a mini one, which integrates components such as the processor, memory, IO expansion, etc., to meet the requirements of the smart POS in terms of stability, scalability, etc. while providing excellent computing power requirements.

GIFA Industrial Control provides smart POS mini motherboards based on Intel® Smart POS Module (Intel® SPOSM) and equipped with Intel® Core™ processors/Intel Atom® processors, providing powerful arithmetic support for both new workloads such as AI and traditional workloads. Among them, Intel® Core™ processors/Intel Atom® processors are ideal for smart POS builds because of their strong computing power, low power consumption, cost-effectiveness, and security.

The new generation Intel® Core™ processors/Intel Atom® processors are the latest generation of processors based on the Intel 7 technology. Compared with the previous generation of processors, the new generation of processors achieves performance improvements in single-threaded processing, multi-threaded processing, and graphics processing. The processor integrates Intel® Iris® X graphics with up to 96 graphics execution units to support multiplexed video processing. The combination of next-generation Intel® Core™ processors/Intel Atom® processors and Intel® Torch® X graphics delivers powerful AI algorithms.

GIFA Industrial Control smart POS mini motherboard adopts USB Type-C to expand various functional interface boards, making the internal wiring of the machine more concise and more flexible in expansion. At the same time, the use of the modular design of the motherboard greatly shortens

the product development cycle, to meet the cash register's complex design requirements, and serialized combination requirements.

In addition to the former cash register function, the all-in-one smart POS device based on the GIFA Industrial Control smart POS mini motherboard also has the functions of a front server, gateway, network switch, and monitoring video recorder. For convenience stores and exclusive stores, smart stores can make full use of the hardware and network interface resources of smart POS and integrate multiple components of smart stores in one POS system, making smart POS the core of smart stores.



Figure 3. GIFA Industrial Control Smart POS Mini Motherboard

### ISV – Smart POS Algorithms

Deep learning algorithms are the key technology for smart POS to make breakthroughs in areas such as the smart identification of products. Compared with traditional machine learning algorithms, deep learning techniques can use large-scale data for model training and continuously improve accuracy and speed in subsequent training. In addition, deep learning techniques can extract features directly from the data, which can significantly reduce the workload of designing feature extractors for each problem.

Convolutional Neural Networks (CNNs) are deep neural network models widely used in smart POS. CNNs are feedforward neural networks that include convolutional computation with deep structure. They are widely used in the field of computer vision, outperforming traditional methods for tasks such as image classification, target detection, and semantic segmentation. Since smart POS typically adopts mini devices for deep learning inference, smart POS may employ model compression by pruning, weight decomposition, precision reduction, and shared weights to improve performance.

Winmore Digit combines technologies such as deep learning, and computer vision with industry know-how to develop the intersectional self-supervised codeless product recognition solution. The solution can widely support various codeless products such as fruits, vegetables, dry food, snacks, seafood, etc. Users can simply place the codeless products on the electronic scales installed with Winmore Digit’s recognition algorithm software to automatically identify the product information and then directly transmit it to the cashier system for collection.

The solution identifies and weighs more than 2,200 common non-barcoded products, such as fresh produce, bulk dry food, meat, and seafood, with over 99% accuracy<sup>3</sup>. It delivers a high level of accuracy in challenging situations, including distinguishing products with even minor differences in

appearance. The artificial intelligence visual recognition model also delivers low latency, with recognition durations of less than 0.2 seconds in trained deployments<sup>4</sup>.

The solution can be easily integrated into mainstream and existing hardware to perform AI visual recognition in any retail environment, while improving itself over time. As the recognition process runs continuously, it will insist on self-training, transaction-based model and algorithm updating to ensure the accuracy of recognition over time. With additional recognition capabilities such as weight patterns, loss reporting patterns, and cash register patterns, retailers can access all of their accumulated data in one centralized data management platform, providing visual results for smart decision-making.

Winmore Digit’s deep learning algorithms have been successfully validated and run efficiently on Intel® processors. Winmore Digit also optimizes its algorithms with the OpenVINO™ Toolkit, a comprehensive suite of tools for the rapid development of applications and solutions to address a variety of tasks including human vision simulation, automatic speech recognition, natural language processing, and recommender systems. The Toolkit is based on a new generation of artificial neural networks, including convolutional neural networks (CNNs), recurrent networks, and attention-based networks that scale across Intel® hardware for computer vision and non-vision workloads to improve performance. It accelerates applications with high performance, artificial intelligence, and deep learning inference from edge-to-cloud deployments.

Winmore Digit provides partners with algorithm integration services, which can integrate Winmore Digit’s deep learning algorithms into product recognition devices and solutions through open API invocations, integrated UI, classes, and libraries, etc. to realize one-stop product recognition applications.

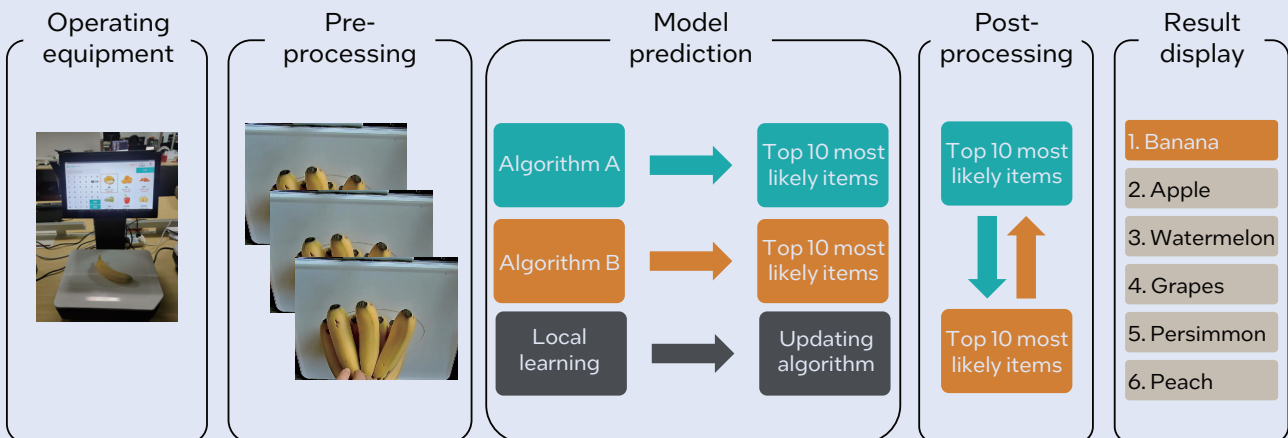


Figure 4. Winmore Digit Intersectional Self-Supervised Codeless Product Identification Process

<sup>3,4</sup> Data from Winmore Digit’s internal test results. Intel does not control or audit third-party data. You should review this content, consult other sources, and confirm whether referenced data are accurate.

### OEM – Smart POS All-in-One Device

Based on the smart POS hardware design, the smart POS all-in-one device integrates AI algorithms and software for product management and payment management, while providing differentiated product options for different application scenarios and users. Users can directly choose the smart POS all-in-one device to achieve rapid deployment.

HICS has launched the Intel® architecture-based “Scale” (Hengqi) series of smart POS machines, offering a wide range of products such as smart cash register scales. The series can be equipped with Intel® processors and integrated cameras for product and barcode recognition to achieve codeless and senseless checkout, supporting payment methods other than QR code checkout and membership cards, prepaid cards, WeChat, and Alipay.



Figure 5. HICS “Scale” (Hengqi) Series Smart POS All-in-One Machine

Intel® processors provide strong general-purpose computing power and excellent low-power performance. Combined with the excellent parallel processing power of Intel® core graphics cards, they offer tremendous advantages in high availability, scalability, and security, laying a strong computing foundation for HICS’s smart POS all-in-one machine. In addition to high performance, low power consumption, stability, and high availability, the Intel platform also features strong peripheral compatibility, supporting smart POS all-in-one machines with different peripherals, and providing a variety of functional support to meet the self-checkout needs of different scenarios.

The “Scale” series of smart POS all-in-one machines support AI product recognition, enabling smart recognition of vegetables, fruits, snacks, baked pastries, etc., improving weighing efficiency while reducing cashier requirements. According to the data, the “Scale” series of smart POS machines can achieve 99%+ fresh food recognition accuracy, and 95%+ snack food recognition accuracy, with a recognition speed of less than 200ms, which has been well received by retailers<sup>5</sup>.

门店	日期	有效条数	命中率	TOP1	TOP2	TOP3	平均输出	搜索占比
...	2022-12-15	293	100.00%	89.42%	96.25%	97.27%	4.71	0.00%
...	2022-12-14	706	100.00%	91.22%	97.59%	99.15%	4.7	0.14%
...	2022-12-13	572	100.00%	93.88%	98.43%	99.13%	4.58	0.00%
...	2022-12-12	670	100.00%	91.19%	97.01%	98.81%	4.61	0.15%
...	2022-12-11	1171	99.74%	90.52%	96.41%	97.87%	4.59	0.43%
...	2022-12-10	1383	100.00%	91.47%	97.40%	98.41%	4.57	0.29%
...	2022-12-09	1148	99.56%	90.07%	97.65%	98.61%	4.57	0.52%
...	2022-12-08	515	99.81%	92.23%	97.48%	98.83%	4.54	0.19%
...	2022-12-07	858	99.88%	88.69%	97.44%	99.07%	4.66	0.12%
...	2022-12-06	975	99.49%	86.97%	96.31%	97.85%	4.6	0.72%

Figure 6. HICS Smart POS Product Identification Data<sup>6</sup>

The “Scale” series of smart POS all-in-one machines also adopt the high-definition full-screen narrow-border touch all-in-one machine + payment printing magic box CUBE X to create an all-in-one machine with flexible conversion for manual or self-help cash register. It adopts functional and structural components such as brackets to create load-bearing capacity. It can also meet the needs of personalized self-service terminals through flexible adjustment of horizontal and vertical screens and high/low positions, thus providing an improved unmanned retail experience.

<sup>5,6</sup> Data from HICS’s internal test results. Intel does not control or audit third-party data. You should review this content, consult other sources, and confirm whether referenced data are accurate.

## Outlook

AI and IoT technologies are giving rise to a far-reaching change in the retail industry. With smart POS solutions deployed to drive smart retail transformation, retailers are expected to accelerate retail business efficiency and realize greater value in massive amounts of retail data. Especially after the COVID-19 pandemic, smart POS solutions will help retailers provide an efficient and personalized offline service experience for users, thereby regaining the favor of consumers and capturing higher business growth.

Following the upgrade of hardware computing power and the innovation of software and algorithms, AI POS solutions will carry an increasing number of traditional loads and AI loads. Especially for small and medium-sized retailers who lack capital investment and technical strength, smart POS devices are expected to become the “Smart Retail Brain” to fully support the digital business in stores and meet the needs of payment management, marketing management, supply chain management, security management, etc.

Thanks to smart POS and other retail solutions, Intel has been integrating innovative technologies such as computer vision, artificial intelligence, and virtualization to become the “Smart Brain” of retail service providers. It can help retailers accelerate the innovative application of new technologies such as artificial intelligence, cloud computing, IoT, and mobile Internet to personalize the in-store experience and fast payment management, thus helping to enhance competitive advantages, shake off the sluggish industry environment, and provide unlimited innovation possibilities for the future.

Intel has been contributing to the new changes in the retail industry by providing reliable, efficient, and easy-to-use smart retail solutions to facilitate industrial transformation and innovation. Looking ahead, Intel will work together with a wide range of partners including ODMs, OEMs, and ISVs to drive innovation in AI POS solutions. Intel will also help retailers reduce the cost of smart POS deployments, provide rapid access to in-store information and data, and deliver data-driven insights that will revolutionize business operations and improve service capabilities and operational efficiency.



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