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A Lenovo + NVIDIA® eBook: Revolutionizing Retail and Restaurant operations with edge AI

How edge-based AI technology enables the retail, restaurant, and quick-service restaurant (QSR) industries to address big challenges and deliver better retail operations and customer experiences.

Introduction

The retail and restaurant industries have transformed post-COVID-19. Underlying factors driving this transformation are operational changes, price-conscious consumers, and increased costs. Perhaps most notable is the growth of e-commerce, with online sales accounting for 20% of all retail sales in 2022.[1]

The transition has been especially disruptive. The retail industry is experiencing large-scale store closures, difficulties finding and retaining employees, and reduced profit margins. Edge computing resources are the critical foundation the retail industry needs to deliver exceptional customer experiences, improve operational efficiency, overcome staff shortages, and shift to omnichannel commerce.

Despite this shift in the market landscape, physical stores have managed to remain competitive by investing heavily in customer experience and improving the overall quality of their services. By leveraging new technologies and building effective omnichannel strategies, retailers and restaurants — including grocery stores, department stores, gas stations, and quick-service restaurants — have improved operational efficiency and provided consumers with an enhanced overall experience while maintaining profitability.

The modern consumer demands personalization more than ever before. According to a recent study by Accenture, 73% of consumers say they have higher expectations of customer experience than just one year ago, with 89% of consumers now expecting companies to anticipate their needs and provide relevant recommendations based on personal interactions.[2] In addition to personalization, research shows consumers want flexibility and a seamless, integrated online-in-store experience.

Delivering on consumer expectations of real-time, personalized experiences requires retailers to innovate with new technologies. By deploying edge computing, retailers and restaurants can reduce latency in their data-intensive applications, enabling the processing of large amounts of data on-site without having to send it offsite. The impact is faster, more accurate, automated decision making for personalization, and the potential to offer flexible and secure multitouch experiences, like quick and efficient self-service options.

The retail and restaurant industries are set to benefit significantly from the rise of cutting-edge technologies such as artificial intelligence (AI), machine learning, and augmented reality. To stay competitive and take advantage of the real-time insights, operational augmentation, and improved customer experience, successful retailers and restaurants are seeing a need to invest in AI computing at the network's edge.

A competitive advantage through cutting-edge technology

Edge computing is transforming businesses in every sector, dramatically improving customer experience and operational efficiency. By taking data processing to the edge, stores can work locally without relying on a centralized data center or cloud solution.

Edge AI allows enterprises to analyze data in real time, resulting in faster decision making. Leveraging AI at the edge, organizations can rapidly process and analyze data where it originates, enabling real-time predictive analytics and an array of customer experience and operational benefits. Edge AI can detect and identify objects in real time, streamline customer interactions, provide personalized recommendations, and optimize inventory management.

Edge AI uses machine learning and relies on powerful Graphics Processing Units (GPUs) for visual recognition, natural language processing, audio analysis, robotics control, and other advanced applications.

Through edge computing, Internet of Things (IoT) device deployment benefits from improved speed, availability, and security as data never leaves the localized environment during the analysis process.

Image courtesy of NVIDIA

[1] Statista, 2022
[2] Accenture, 2021, The Retail Experience Reimagined

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Adapt to survive: the dynamic landscape for retailers and restaurants

Traditional stores are experiencing a period of profound market change — evolving consumer behavior following the COVID-19 pandemic, technology transformation, competition from online retailers, and rising labor and operational costs.

Consumers are now more likely to seek convenient, personalized service delivery. 90% are willing to pay extra for a better experience,[1] with 74% prepared to travel up to five minutes further to reach their preferred gas station/food retail location.[2]

With e-commerce expected to reach 21% of retail sales in 2023, 79% of sales will be in physical stores.[3] Edge AI presents enormous competitive advantage opportunities over pure digital retailers, with AI's ability to provide in-store the same type of insights gleaned from digital channels. Insights on real-time loss prevention, stock-out, merchandising, store operations, and customer service enable effective decision making, helping retailers and restaurants optimize back-office processes and drive operational efficiencies.

The restaurant industry has also been affected by changing consumer behavior and market forces. Increased competition, demand for home deliveries, supply chain complexities, rising labor costs, labor shortages, and labor turnover continue to pose problems. The number of people using online food delivery services is growing at 25% per annum (American Journal of Transportation).[4]

79% of retailers and restaurants are looking to expand their omnichannel strategy.

51% of retailers and restaurants are focusing on reducing operating costs.

47% of retailers and restaurants are optimizing inventory and product choices.

39% of retailers and restaurants are seeking efficiencies through automating tasks.[5]

Grocery market

Although only 11% of the grocery market has moved online, online services have increased competition and challenged consumer loyalty.[6] Supermarkets have responded to well-priced, highly convenient online services by offering ordering and delivery services or partnering with third-party providers. Stores are also investing heavily in technologies, such as self-checkouts, autonomous shopping, mobile payments, and IoT devices, to meet customer demand for ease of use, quality of service, and speed of interaction.

Retail market

Over the last decade, physical stores have seen a decline in sales as consumers turn to online retailers. This general trend became a market transformation through the COVID-19 pandemic, and 55% of retailers cited winning foot traffic as a top challenge in 2022 and beyond.[7] In response, stores have introduced unique on-site experiences, interactive displays, branded boutique-style shops, and omnichannel ordering services to maximize returns from their store footprint while searching for cost and operational efficiencies. Other retail segments, such as fashion, convenience stores, and gas stations, have reacted by offering omnichannel, grab-and-go options, and mobile and fast payment services.

Gas and fuel retail market

This retail market is highly competitive, with operators vying for customers by offering convenience, value-added services, and loyalty programs. Many are investing in technologies, including automated pumps, mobile refueling solutions, and contactless payments to enhance customer experience. Operators also leverage data analytics to optimize fuel pricing and promote customer loyalty. A 2022 NACS Pulse Survey found that 67% of convenience retailers say consumers would drive five minutes out of their way to save five cents per gallon.[8]

Restaurants and QSRs

Restaurants are investing heavily in customer experience and technology, turning to mobile ordering systems, digital loyalty programs, automated kitchen equipment, and food delivery services to keep up with consumer demand. 92% of top-performing restaurants offer mobile order-ahead and loyalty rewards programs, or a combination of both (PYMNTS.com).[9]

[1] Forrester, 2022, How Customer Experience Drives Business Growth
[2] NACS, 2022, Convenience Retailers and Consumers Agree: A Good Experience Tops Price
[3] Statista, 2022
[4] American Journal of Transportation, 2021
[5] NACS, 2022, Convenience Retailers and Consumers Agree: A Good Experience Tops Price
[6] S&P Global Market Intelligence, 2022
[7] Shopify, 2022
[8] NACS, 2022, Survey: A Good C-Store Experience Tops Price
[9] PYMNTS.com, 2021, Digitizing Restaurant Payments Report

Retailers and restaurants are harnessing the power of edge AI

Technology is driving industry transformation. Innovations such as AI, IoT, mobile payments, analytics, and cloud computing are helping physical retailers and restaurants create new services, increase customer satisfaction, reduce costs, and improve operational efficiencies.

Retailers and restaurants must be more responsive to stay ahead of the competition. This requires reliable, rugged, and scalable technical infrastructure to process vast amounts of data on-premises at speed. These challenges have pushed organizations to the edge, making store-level edge computing a critical component of technology implementation for large, dispersed retailers and restaurants.

With consumers demanding more personalization, retailers and restaurants are increasingly investing in technology solutions to build brand loyalty. A recent study found 73% of retailers currently view edge computing as a strategic investment, with almost half looking to increase their investment in the technology in the next year.[1]

From supply chain challenges to the dramatic shifts in consumer buying behavior, today more than ever, retailers and restaurants need the agility to respond to these changes. The following are just some of the many ways they are leveraging AI to meet market demands:

Intelligent Stores and QSRs

Autonomous Shopping

- Autonomous Checkout
- Nano Stores
- Smart Cabinets

Store Analytics

- Stock-Out and Real-Time Alerting
- Planogram Compliance
- Heat Mapping
- Queue/Wait Time Management
- Demographic Analysis
- Shopper/Employee Tracking and Engagement
- Employee Staffing Forecasting
- Curbside Pickup
- Sanitation Management

Asset Protection

- Ticket Switching
- Mis-Scanning
- Employee Theft

Drive Thru

- Automated Voice Order Taking (Kiosk/Mobile App)
- Multi-Modal Recommendations
- Drive Thru Queue Management
- License Plate Recognition (LPR) & Pickup
- Exterior Security

Kitchen

- Production Quality Inspection
- Product Waste
- Product Spoilage/Food Safety

Omnichannel Management

E-commerce/Digital

- Customer 360
- AI Product Meta-Tagging & Cataloging
- Personalized Recommendation Systems
- Recommender Systems
- Visual & NLP Search
- Dynamic Pricing

Conversational AI

- NLP/Chatbots
- Virtual Assistants
- Conversational Commerce

Cybersecurity

- Fraud Detection
- Cybersecurity

Intelligent Supply Chain

Forecasting

- Increased Speed and Accuracy of Forecasting
- Demand Forecasting

Smart Warehouses and Distribution Centers

- Loading Dock Intelligence and Data Capture
- Robotics Pick & Place
- Smart Forklifts, AGVs, and AMRs
- Package Lifecycle Tracking
- Adaptive Speed Conveyor
- Smart Cabinets
- NLP Assistance

Routing Optimization

- Route Optimization
- Last-Mile Delivery

[1] IDC InfoBrief, 2021 Edge Computing: Powering Frictionless Retail

Driving digital transformation with edge AI

Edge AI is transforming the retail and restaurant industries. With smart devices and sensors across stores, restaurants, warehouses, and logistics, organizations can gather and analyze data in real time, make automated and informed decisions, and optimize operations at every stage of the supply chain.

This enables forward-thinking retailers and restaurants to:

1 **Drive revenue**
Edge technologies are revolutionizing the industry by providing more personalization for customers and more data for retailers and restaurants. By distributing processing, storage, and analytics to the point of data capture, real-time insights and automated decision making can unlock revenue opportunities. Through mobile checkouts, self-service kiosks, AI-driven product recommendations, virtual reality shopping experiences, and digital loyalty programs, retailers and restaurants can drive revenue with faster service times and better experiences.

2 **Reduce costs**
Edge computing transforms how retailers and restaurants manage their internal operations. Investing in automation frees up staff, offering cost-saving opportunities or allowing additional focus on customer experience. Forecasting demand for products enables organizations to optimize stock control and staffing levels, improving operational agility and efficiency.

3 **Improve technology and network management**
Remote retail and restaurant settings are vulnerable to network disruption. Data processing and local storage maintain less reliance on network availability and speed. This reduces latency and improves the user experience for all IoT devices. Edge AI can also support network performance, by providing real-time analytics and insights to support optimization, while offering significant ESG (Environmental, Social, and Governance) advantages. Centralized data centers consume large amounts of energy, produce high carbon emissions, and generate substantial electronic waste. Many data centers are switching to green energy to offset this, but edge computing offers a superior solution. Locally processing and storing data reduces cloud traffic and energy consumption and is a step toward a more sustainable computing future.

The retailers and restaurants benefiting:


Grocery stores


Department stores


Fashion retailers


Gas stations/ convenience stores


QSRs

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Bringing agility and insights to every stage of the supply chain

Drive customer experience

Smart kiosks and conversational AI:
Use smart devices, touchless kiosks, automated voice order taking, and avatar-based assistant technology to process customer orders efficiently, using machine learning to analyze buying patterns, recognize repeat customers, and make personalized upsell suggestions.

Queue and wait-time management:
Utilize intelligent video analytics and pre-installed security cameras to determine queue length and wait times, identify bottlenecks, and alert store management to resolve issues before customers become frustrated or abandon their purchase.

Omnichannel experiences:
Use AI and analytics to provide customers with a unified shopping experience. Share in-store promotions, stock levels, and customer reviews. Offer customers the option of ordering on mobile apps and online for collection in-store.

Curated customer experiences:
Drive perceived tangible value across a buyer's entire lifecycle by combining customer data with AI-driven analytics. Develop an understanding of tastes and preferences for ultra-personalized product recommendations, discounts, and experiences.

Demographic analysis:
Gather and analyze anonymous demographic data. Learn about customers with privacy preserved. Continuously optimize messaging and advertising with amplified personalization.

Interactive signage:
Transform in-store experiences with personalized signage and deliver customized offers to known customer preferences in a live context.

Virtual mirrors:
Offer customers the opportunity to visualize apparel without the need to try the clothing on through augmented and virtual reality.

Sanitation management and alerts:
Monitor cleaning and garbage removal. Alert staff when action is needed and empower AI to suggest more efficient cleaning rotations.

Interior/exterior security and safety:
With surveillance video and audio processing, analyze events and identify suspicious or unsafe behavior in real time, perform automated safety actions using machine learning algorithms, or alert security to protect customers, employees, and the business.

Image courtesy of NVIDIA

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Achieve operational efficiencies

Inventory inspection:
Leverage computer vision to inspect and monitor inventory and gain a real-time understanding of stock/food levels and status.

- In retail and QSRs, gather insights for loss prevention and accidents, shrink, and inventory waste reduction.
- In restaurants, use machine learning to warn or alert staff when food is approaching or beyond acceptable quality thresholds.

Asset protection:
Protect retail assets with machine learning to detect anomalous behavior and potential threats at the point of sale; for example, mis-scans, ticket switching, unauthorized discounts, and self-service theft.

Centralized management:
Efficiently manage dynamic menus, advertising promotions, and infrastructure through a centralized hub and spoke system deployed through edge technology.

Forecasting:
Use machine learning to predict footfall, product sales, and required inventory per store based on customer segments, day of the year, historical data, upcoming events, weather conditions, and promotions.

Staffing forecasting:
Track workload and expected customer traffic and forecast future staffing requirements. Use machine learning to generate staff schedules based on employee preferences.

Maintenance and management:
Detect equipment malfunctions before they occur and perform proactive maintenance to prevent costly disruptions of air conditioning units, refrigeration systems, lighting solutions, and more.

Energy management:
Leverage edge technology to sense motion, occupancy, and weather conditions for efficient energy management, reducing operating costs and benefiting the environment. Edge computing eliminates the need to send data to a data center, reducing cloud traffic and energy consumption. At scale, this dramatically reduces energy consumption and carbon emissions, making edge computing a highly sustainable solution.

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Deploying edge AI solutions

When deploying retail edge infrastructure, stakeholders must consider the long-term cost implications and return on investment rather than taking a short-sighted approach of focusing on upfront costs. A smart investment in reliable components with longer lifecycles can pay off by reducing total ownership expenses — ensuring stable performance, and minimizing manual and equipment interventions that prove costly over time.

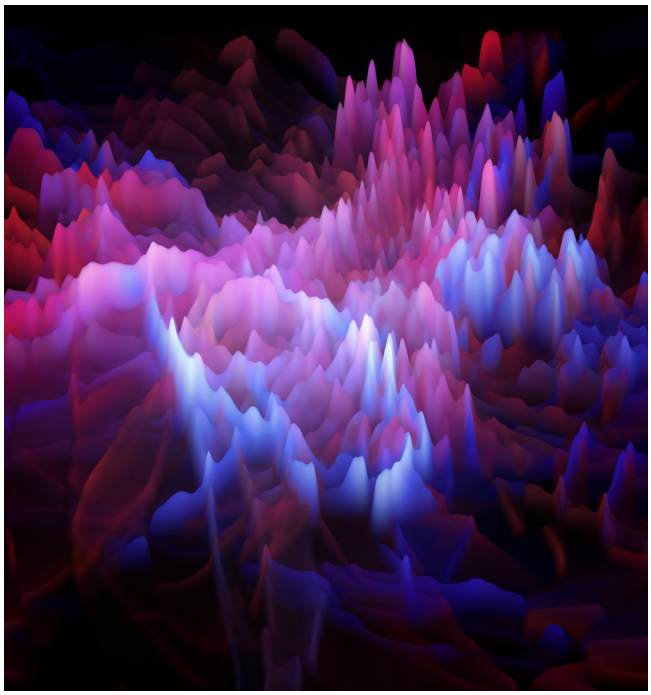
Edge computing infrastructure

IoT edge devices:
Edge devices capture and process user input, sensor- or camera-generated data. Edge devices can operate independently or in a connected state with cloud resources.

Edge computing:
Edge computing brings data processing to the network's edge, reducing latency and enabling faster decision making.

Edge storage:
Edge storage allows users to store data locally, securely, and reliably at the network's edge.

Edge servers:
Edge servers can store, process, and analyze data quickly and efficiently. Edge servers can also manage traffic loads, providing additional performance optimizations.



A Lenovo and NVIDIA solution

Computing:
Lenovo offers a breadth of purpose-built and edge computing solutions to power industry-leading performance, security, and manageability.

Servers and storage:
Lenovo ThinkEdge and ThinkSystem servers provide a full range of ruggedized, industry-leading solutions, delivering performance, security, and scalability at the core, near edge, and far edge, backed by enterprise-grade support. Lenovo's easy-to-manage storage offers compact flexibility and manageability, explicitly designed for edge environments.

Kubernetes:
Lenovo and NVIDIA offer a leading purpose-built solution for deploying, managing, and monitoring applications at the edge. The NVIDIA GPU Operator and NVIDIA Network Operator standardize and automate the deployment of all components for provisioning Kubernetes clusters.

NGC software catalog:
The NVIDIA NGC software catalog is the hub for performance-optimized deep learning and machine learning applications. NGC simplifies building, sharing, and deploying software, allowing retailers and restaurants to gather insights faster and deliver value sooner.

NVIDIA AI Enterprise:
NVIDIA AI Enterprise is an end-to-end, cloud-native suite of AI and data analytics software, optimized for every organization to excel at AI, deployed on Lenovo NVIDIA-Certified Systems, and includes global enterprise support so AI projects stay on track, allowing organizations to focus on harnessing the business value of AI.

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EDGE AI SOLUTIONS FOR RETAILERS, RESTAURANTS, & QSRs

AI SOLUTIONS FROM ISVs & TECHNOLOGY PARTNERS

Customer Experience Examples

- Autonomous Shopping
- Queue Management
- Adaptive Advertising
- Last-Mile Delivery

Retail Operations Examples

- Loss Prevention
- Stock-Out Alerts
- Store Analytics
- Safety and Security

AI LIBRARIES, TOOLKITS, AND CONTAINERS

NVIDIA Software Catalog (NGC)

EDGE AI-READY TECHNOLOGY AND INFRASTRUCTURE

Virtualization Technology and Management

- Hypervisors e.g. VMware ESXi
- Storage e.g. VMware vSAN
- Management e.g. Lenovo XClarity, VMware vSphere

Lenovo Server & Edge Technology

- ThinkEdge Clients & ThinkStation Workstations e.g. SE70, P360
- ThinkEdge Servers e.g. SE350, SE450
- ThinkSystem Servers e.g. SR630, SR645

Lenovo ThinkSystem and ThinkEdge solutions enabling edge AI:

Lenovo delivers NVIDIA-Certified high-performance AI servers, digital twin-ready infrastructure, and ruggedized edge servers as the foundation to edge AI solutions for the retail and restaurant industries.

Lenovo ThinkSystem Servers (such as the SR630 V3 shown), supporting a variety of NVIDIA GPUs, ideal for handling data-hungry AI and analytics, as well as supporting hybrid cloud, HCI, video surveillance, and high-performance computing.

Right-sized Lenovo ThinkEdge Servers (such as the NVIDIA-GPU-powered SE70, or the SE450 shown), designed to meet remote location needs and capable of running AI at the edge.

Lenovo Local Cloud Automation (LOC-A) is a software solution that helps customers simplify and accelerate edge deployments for any number of locations at once — quickly, consistently, and automatically. LOC-A and XClarity edge device management applications expand options and improve control, from far edge to core:

- Diverse Portfolio: from ultra-compact gateways to data center-grade products
- Highest Performance: CPU- & GPU-rich systems for ultimate performance
- Flexible Deployment: in harsh environments with ruggedized devices and unique cooling capabilities

The Lenovo advantage

Lenovo's edge portfolio offers a one-stop shop and a complete end-to-end edge deployment solution for all enterprise organizations. The portfolio includes:

- **Lenovo ThinkEdge SE70:** provides enterprise-changing AI and ComputerVision applications constrained only by imagination. With best-in-class engineering, reliability, and scalability, the SE70 transforms existing camera infrastructure into intelligent automated environments ideal for every industry.

- **Lenovo ThinkStation P360 Workstation:** features scalable hybrid architecture, data integrity, and built-in security. With professional NVIDIA graphics, including VR-Ready NVIDIA® RTX™ A5000, ultrafast DDR5 4000MHz memory, and dual M.2 NVMe PCIe Gen 4 SSD storage, the P360 offers eco-certified performance for all users.

- **Lenovo ThinkEdge SE350:** built with the unique requirements for edge servers in mind, it is versatile enough to stretch the limitations of server locations, providing a variety of connectivity and security options and easily managed with Lenovo XClarity Controller. The SE350 is a rugged, compact-sized edge solution with a focus on smart connectivity, business security, and manageability for the harsh environment.

- **Lenovo ThinkEdge SE450:** is an advanced processor-based server with a 2U height and short depth case that can go almost anywhere. It can be hung on a wall, stacked on a shelf, or mounted in a rack. This rugged technology can handle continuous operating temperatures from 5°C and 45°C, with designs configured to meet NEBS Level-3 and ETSI requirements for 96-hour operating excursions from -5°C to 55°C as well as tolerance for locations with high dust and vibration.

- **Lenovo ThinkSystem SR645:** combining performance and flexibility, the SR645 V3 server is a great choice for enterprises of all sizes. With flexible storage configurations, it supports 3x single-width GPUs.

Lenovo edge servers are rugged and secure with physical tamper-proofing, data encryption, and the ability to withstand conditions of all kinds.

A hybrid multi-cloud brings flexibility

The Lenovo edge ecosystem is open and flexible, and it integrates with all key cloud providers offering end-to-end, ongoing management.

Extend cloud performance with a resilient edge

Get integrated, cost-effective, and resilient edge solutions that are easy to deploy, simple to operate, and maximize edge workload performance.

Improve data management and access

Enjoy better data management with the widest choice of products, services, and, most importantly — guidance available for advanced hybrid infrastructure.

Edge AI in action

Shaping the self-checkout of tomorrow

Headquartered in Cincinnati, Ohio, Kroger Co. is the largest supermarket chain in the United States in terms of revenue, operating a vast retail network of supermarkets, pharmacies, fuel centers, and multi-department stores throughout the U.S. With revenues of $132.5 billion in 2020, the company operates 2,750 grocery stores in 35 states under various local banner names.

Kroger aims to deliver an experience that's quick, easy, and convenient. As part of this remit, the company has been steadily expanding the use of self-service checkouts (SCOs) at locations across the country. Kroger found a capable solution in Everseen's Visual AI™, which uses high-resolution cameras and a unique combination of computer vision and AI. The application is on NVIDIA's Accelerated Computing AI Platform and shapes shopper and associate behavior at SCOs, prompting staff intervention when errors occur.

The platform captures vast volumes of unstructured video data, which it integrates with structured point-of-sale data feeds, analyzing in real time. Kroger's task was to find a computing infrastructure that was up to the challenge of processing large amounts of data quickly and cost-effectively.

Following a successful pilot implementation of the Lenovo and Everseen solutions, Kroger moved at speed with its deployment and has already rolled out the AI platform at 1,700 grocery stores and counting, with plans to have the new solution up and running at all Kroger locations.

The Visual AI™ application from Everseen running on Lenovo servers analyzes the real-time video footage from checkout kiosks to recognize regular processes and intelligently step in whenever something is amiss. This covers the straightforward "non-scan" — when a customer or cashier fails to scan an item — to more targeted and intelligent use cases of product switch, such as when a customer removes the price sticker from a product and places it over the barcode of a more expensive item.

With high-performance Lenovo edge AI servers powered by the NVIDIA Accelerated Computing AI Platform, Kroger can process and analyze vast volumes of video data at the edge in real time, ensuring reliable performance for its Everseen Visual AI™ platform.

This has added an all-new layer of intelligence at checkout, reducing customer friction and helping Kroger's associates work more effectively.

"We're reporting fewer errors at self-checkout. Not only does this translate into reduced retail shrink, it also gives us a much more accurate view of what stock is going out of the store. This allows us to stay on top of replenishing inventory, which boosts on-shelf availability for customers and ultimately increases our sales."

Chris McCarrick
Senior Manager of Asset Protection Solutions & Technology, Kroger[1]

Kroger

[1] https://www.lenovo.com/us/en/resources/data-center-solutions/case-studies/Kroger/

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Edge AI deployment considerations

As innovation revolutionizes the retail and restaurant industries, strategic partnerships with reliable technology providers should equip organizations with the cutting-edge technology they need to remain competitive. When implementing edge solutions, decision makers must consider multiple factors to maximize success.

Functionality:
Edge applications require a combination of sensors, cameras, human inputs, and other AI-based technologies. Retailers and restaurants should work with a technology provider to plan their applications and hardware requirements, determining hardware suitability, scalability, and flexibility for software, applications, and bespoke developments.

Cost:
Cost and cost-benefit analysis are critical stages in all technology asset investments. For edge computing, retailers and restaurants should factor technology lifetime cost over the initial cost, as the cost of development, maintenance, technician support, and equipment replacement will likely outweigh the initial cost over the entire technology lifecycle.

Space/footprint requirement:
Floor and storage space in retail and restaurants is at a premium. When planning for edge solutions, organizations should consider the size and shape of the technology and space available to confirm suitability and operability in the desired environment.

Environmental factors:
Energy efficiency is a vital consideration for every technology deployment. Power consumption, remote power management, and power modes are all important factors for selecting an edge solution. Environmental factors should also include sound, heat, and dust management. Edge computing is often the ideal solution for locations where low to no noise is required — with fanless and sound-optimized devices available. For heat management, edge computing can include thermal solutions to deliver performance without ventilation — operating in locations where several heat sources can contribute to high temperatures, e.g., in storage rooms and industrial kitchens. Ruggedness and dust resistance are further common deployment considerations for environments with high levels of dust or humidity.

Integration:
The integration of IT (Information Technology) and OT (Operational Technology) systems is critical to the success of edge solutions. Edge computing should converge information and operational technology, allowing easy two-way communication and data sharing. This open system communication can improve usability, power automation, data-driven decisions, and operational performance while reducing the risk of data breaches.

Maintenance:
Retailers and restaurants should research the planned maintenance protocols for their edge solutions. How frequently do updates need to be applied? How often does hardware require servicing? Who will support system faults, and what are the associated costs of these services?

Privacy and security:
Edge solutions often capture and store sensitive data. Retailers and restaurants should enforce privacy and security measures in deploying their network, and use edge technology to ensure compliance with industry regulations and data protection policies.

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Reimagining sustainability with Lenovo

Smarter is building a more sustainable future. Lenovo is committed to supporting our customers' efforts to reduce their environmental footprint. Lenovo is dedicated to being a leader in the development of technologies that minimize the use of the world's precious resources.

Sustainability begins in the early stages of product design. From the composition of the materials in the technology, to innovations in eco-friendly packaging, Lenovo not only delivers world-class solutions, we deliver on sustainability for your organization.

Committed to the environment from acquisition to disposal, Lenovo:

- Has introduced the use of ocean-bound plastic into our server bags, composed of 30% abandoned plastic waste once at risk of landing in the ocean.
- Uses high recycled content or material made of 65% pre-consumer recycled content.
- Ensures all packaging materials, including cardboard, foam cushion, and plastics are 100% recyclable.
- Produces server products using post-consumer content (PCC) and closed-loop post-consumer content.
- Employs innovative, energy-saving components like Neptune™ liquid cooling and energy control software.

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In partnership with NVIDIA, Lenovo is developing world-changing technologies to create a more efficient, connected, and digital society. By designing, engineering, and building the world's most complete portfolio of innovative, edge AI-ready devices and infrastructure, Lenovo and NVIDIA are leading an intelligent transformation — to create better experiences and opportunities for millions of customers worldwide.

Accelerating AI relies on GPUs, and NVIDIA delivers GPU acceleration everywhere it's needed — to data centers, desktops, laptops, and the world's fastest supercomputers. As companies are increasingly data driven, the demand for AI technology grows. From speech recognition to recommender systems and supply chain management, AI technology provides enterprise teams with the power, tools, and algorithms to work effectively.

Lenovo edge computing empowers users to solve real-world challenges with robust infrastructure solutions that generate faster insights. Complex organizational and business decisions can be made quickly, and with a higher level of confidence, with ThinkEdge servers that are rugged and secure with physical tamper-proofing, data encryption, and the ability to withstand conditions of all kinds. So no matter what you need, we'll find the right solution for you.

Lenovo and NVIDIA bring innovative solutions and intelligent infrastructures to solve the most significant challenges of today and tomorrow. Together, we equip data-centered researchers, pioneers, and visionaries across all industries with the tools to help them evolve, transform, and implement enterprise AI solutions to deliver Smarter Technology for All.

Find out more

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