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A Lenovo + NVIDIA[®] eBook: Industry transformation driven by edge AI

How edge AI technology is helping modern businesses from all industries overcome challenges and deliver exceptional customer experiences and operational efficiencies.

Introduction

In today's competitive landscape, staying ahead of the competition means staying ahead of the technology and innovation curve.

Over the last 20 years and especially in the years since the recent pandemic, the business world has witnessed incredible technological advancement with the explosion of hardware, software, and data. This has enabled organizations to develop increasingly sophisticated solutions for managing their customers, operations, and cost base. But as technology continues to develop, so does the competitiveness of every industry.

Customers demand tailored, unique solutions, and organizations must keep pace by handling greater volumes of data spanning multiple locations while safeguarding IT systems through an ever-evolving cyber landscape. With additional pressure to optimize operational efficiency, businesses are left searching for ways to deliver customer value amidst increasing complexity.

Latency, scalability, and security issues concern retailers, manufacturers, restaurants, healthcare providers, energy and telecommunication network operators, and even smart spaces — all of which depend on quick access to accurate data to power exceptional customer experiences.

The inefficiencies of centralized data centers transmitting large amounts of data across networks and addressing requests from multiple concurrent users can compromise end-user performance. The risk of server overload, outage, and security vulnerability provides a constant concern for distributed and global organizations.

Edge AI is the solution and the fastest growing segment of enterprise technology. Deloitte Global predicts the enterprise edge market will grow at 22% in 2023, compared to 4% annual growth for enterprise networking and 6% for enterprise IT.¹ This powerful technology enables organizations to manage massive amounts of data on distributed sites or nodes in real time. By bringing processing closer to the data source, organizations can reduce latency, improve responsiveness, and ease the strain on IT networks.

Edge-powered AI brings with it the ability to automate more complex tasks, enhancing predictive analytics and decision-making capabilities. This helps businesses in all industries make quicker decisions, delivering a level of accuracy and flexibility that was never possible with traditional solutions. Edge AI also gives a more holistic view of customer behavior and preferences, helping to enhance customer experiences and optimize operational efficiency.



¹ Deloitte, 2022, Battle for the Enterprise Edge: Providers prepare to pounce on the emerging enterprise edge computing market

Enhanced experiences lead to smarter operations, creating greater efficiency and profitability

Edge computing is transforming businesses in every sector, dramatically improving customer experience and operational efficiency. By taking data processing to the edge, organizations 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 predictive analytics and an array of customer experience and operational benefits. Edge AI can detect and instantly identify objects, streamline customer interactions, provide personalized recommendations, and optimize inventory management.

Edge AI uses deep 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, technology deployment benefits from improved speed, availability, and security as data never leaves the localized environment during the analysis process.

The driving forces behind edge AI adoption

The world is rapidly changing. Developments in technology are forcing organizations to rethink their products, services, and processes. While globalization has opened new markets and opportunities, organizations must keep up with digital transformation, changing regulations, cyber security threats, and emerging trends — such as sustainability, shifting consumer preferences, rising consumer expectations, and increasingly competitive markets. Add to this the global skills shortage, unpredictable energy costs, and the emergence of AI, ML (Machine Learning), deep learning, analytics, automation, and IoT (Internet of Things), and it's clear there is a lot for modern organizations to mitigate and manage.

93% of companies say their industry has become more competitive in the last 3 years.¹

87% of consumers are concerned about data privacy.²

84% of consumers say customer experience is as important as products or services.³

90% of enterprise processes, products, and services will involve AI technology by 2025.⁴

79% of companies report economic uncertainty as a challenge.⁵

75% of companies find talent difficult to source.⁶

The trends

As the digital landscape evolves, technologies such as edge computing, cloud, AI and ML, analytics, and automation enable organizations to capture more data from various sources. AI-driven machine learning allows businesses to process data quickly and accurately. This rigorous analysis has given rise to an abundance of insights that can be used to inform decisions and customize consumer and user experiences.

Organizations can better anticipate and meet customer needs while developing and maintaining highly productive processes. A study by Salesforce found 75% of consumers expect businesses to use new technologies to improve customer experience,⁷ while Vanson Bourne research has found edge computing delivers an average of a 30% improvement in operational efficiency.⁸

Edge AI delivers better customer experiences and greater efficiencies for organizations from all industries. Because of this — and the many other advantages edge AI offers — organizations are investing heavily in the technology.

- **\$274 billion** will be spent on edge solutions in 2025.⁹
- **150 billion** IoT and edge devices will be generating 175 zettabytes of data by 2025.¹⁰
- **50%** of all new enterprise IT infrastructure investment is in edge technology.¹¹
- **75%** of enterprise-generated data will be created and processed at the edge by 2025.¹²

¹ Crayon, 2023, 2023 State of Competitive Intelligence

² KPMG, 2021, Corporate Data Responsibility Report

³ Forbes, 2019 50 Stats That Prove The Value of Customer Experience

⁴ IDC, 2019, IDC: Top 10 Worldwide IT Predictions for 2020

⁵ KPMG, 2022, KPMG 2022 CEO Outlook

⁶ Manpower Group, The Talent Shortage

⁷ Salesforce, 2019, State of the Connected Customer Report Outlines Changing Standards for Customer Engagement

⁸ Forbes, 2023, How the Edge is Becoming the Next Frontier of Value Creation

⁹ IDC, 2022, New IDC Spending Guide Forecasts Double-Digit Growth for Investments in Edge Computing

¹⁰ Deloitte, 2022, Battle for the Enterprise Edge: Providers prepare to pounce on the emerging enterprise edge computing market

¹¹ IDC, 2020, Edge Computing: Not All Edges are Created Equal

¹² Gartner, 2018, What Edge Computing Means for Infrastructure and Operations Leaders

A smart investment for your future

Edge AI is transforming all consumer industries. With smart devices and sensors, organizations can gather and analyze data in real time, automate processes and make informed decisions, and optimize operations at every stage of the value chain — from research and development to manufacturing and logistics to operation.

The three main commercial impacts of edge and edge AI:

Drives revenue: Edge technologies are revolutionizing every industry by providing more personalization for customers and more data for organizations. By distributing processing, storage, and analytics to the point of data capture, real-time insights and automated decision making can unlock revenue opportunities.

Supports cost reductions: Edge computing transforms how organizations manage their internal operations. Investing in automation frees staff, offering cost-saving or cost-reallocation opportunities. Forecasting demand for products enables organizations to optimize stock control and staffing levels, improving operational agility and efficiency.

Enables better technology and network management: Local data processing and storage reduces reliance on network availability and speed. This removes latency and improves the user experience for all IoT devices. Edge AI can also support network performance by providing real-time analytics and insights into customer behavior and usage patterns to support optimal decision making.

Edge AI is powering industry transformation across the globe

Edge AI empowers localized decision makers with predictive insights from real-time data analysis, unlocking superior customer experiences, improving operational efficiencies, and enhancing in-store security.

The industries benefiting:



Smart spaces and security



Retail and restaurants



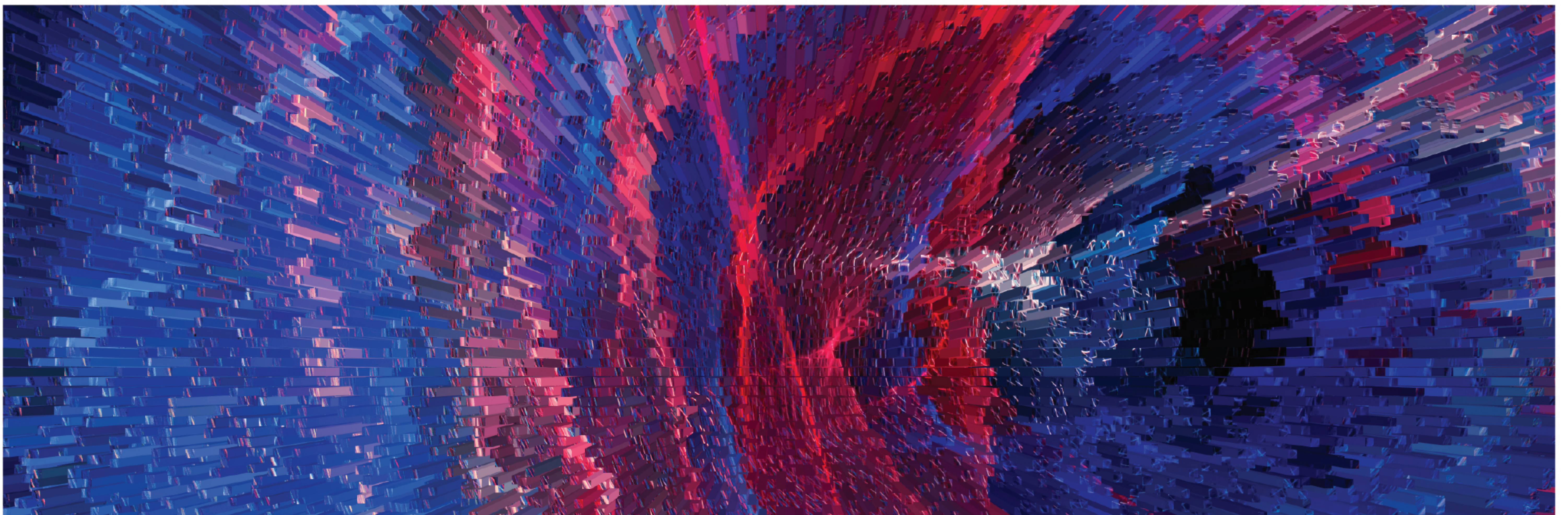
Manufacturing



Healthcare



Energy and telecommunication



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A transformation of every vertical

Smart spaces, retail, manufacturing, healthcare, utilities, and more

Improving the customer experience

Personalized messaging:

Analyze customer data to provide more accurate buyer insights to improve communication.

Faster check-ins and checkouts:

Utilize intelligent video to monitor queue length and wait times and identify and resolve bottlenecks.

Enhanced navigation and mobility:

Provide autonomous navigation around stores, buildings, cities, healthcare, and travel terminals.

Personalized products and services:

Make live recommendations in retail, restaurant, or healthcare settings, and support conversations with AI.

Lower pricing:

Optimize the supply chain for all industries. Enable manufacturers, energy organizations, and telcos to quickly identify patterns and adjust operations.

Improved service experience:

Empower customer service representatives and use machine learning (ML) to identify issues before they become pain points.

Accurate diagnoses and treatment planning:

Enable quicker AI-driven diagnoses, personalized treatment plans, and more accurate predictions to improve outcomes.

More targeted safety:

Analyze events, identify suspicious or unsafe behavior in real time, and perform automated safety actions using ML.

Focused resourcing:

Automatically adjust resources based on customer flow, needs, and requirements for improved efficiency.

Increased product availability:

Predict consumer demands ahead of time and make product delays a thing of the past with AI analysis and forecasting.



Enhancing operational efficiency

Sophisticated traffic management:

Improve business and traveler experience by autonomously analyzing and predictively optimizing transportation routes for improved efficiency.

Efficient energy management:

Monitor energy consumption, predict and identify abnormal patterns, or adjust operations to reduce costs.

Effective infrastructure management:

Proactively monitor and fix infrastructure, performing maintenance before breakpoints to reduce management costs and service availability.

Improved healthcare:

Analyze patient data, videos, and images to identify trends or detect disease early for improved care and outcomes.

Advanced inventory management:

Identify shortages and enable proactive replenishment of inventory and supplies for effective cost management.

Enhanced customer service:

Personalize customer experiences and automate customer service conversations, support, and the sharing of help resources.

Improved fraud detection:

Analyze customer behavior and transaction information to detect suspicious activity and protect organizations and customers from potential issues.

Advanced robotics and automation:

Assist customers to improve service quality and efficiency or automate mundane tasks, like picking and packing items in warehouses.

Enhanced security:

Set up AI-driven access control solutions to ensure safety and security in public spaces and businesses.

Optimization for energy and telco networks:

Monitor and manage electricity, water, gas, or telecom networks leveraging predictive analytics to anticipate issues and reduce manual intervention.

Improved sustainability:

Centralized data centers consume large amounts of energy, produce carbon emissions, and generate 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 future.

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Edge AI for smart cities, spaces, and security



Smart city management



Smart public spaces



Smart buildings



Smart parking

Global urban populations are growing rapidly. Cities are faced with overcrowding, traffic congestion, rising power and waste demands, and increasing pollution levels. In response to these scalability and sustainability concerns, smart city initiatives are being implemented worldwide with edge AI.

Smart cities use IoT devices such as cameras and sensors, and big data analysis to monitor activity within their physical environment and deliver services tailored to citizen or user needs. AI-driven systems are analyzing and optimizing data within smart cities, enabling greater efficiency and accuracy of public and private services.

As cities become increasingly tech-driven, smart spaces have become more common — from airports to shopping malls and hospitals. With this growing connectivity comes a need for powerful and secure data processing and storage to operate quickly while keeping citizens secure. Edge AI is the technology helping cities get the most out of their data, optimizing space, infrastructure, and asset utilization, managing people and traffic flows, energy consumption, and environmental impact in real time to improve experience and operational efficiency while mitigating threats like cybercrime.

- **68%** of the world's 9.8 billion population will live in urban areas by 2050.¹
- Cities consume **78%** of the world's energy and produce **60%** of greenhouse gas emissions.²
- The digitization of services has reduced operating costs for **85%** of cities in the EU.³

Edge AI applications

Airport management: Optimize plane turnaround times, decrease check-in/security lines with passenger counting and heat maps, and understand passenger flow. Reduce traffic congestion and automate parking operations. Detect abandoned and dangerous objects and monitor perimeter fences for intrusion.

Transit hub management: Count vehicles and perform number plate recognition. Optimize kiosk and store operations with analytics and checkout-free shopping. Manage passengers with crowd density analysis.

Traffic/roadway management: Optimize traffic, reduce congestion, and ensure pedestrian safety.

Public safety: Alert security of unauthorized personnel, identify security events such as fire which can be taken care of immediately.



¹ United Nations, 2018, 68% of the world population project to live in urban areas by 2050, says UN

² United Nations, Generating Power

³ OECD, 2020, Smart Cities and Inclusive Growth

Edge AI for retailers & restaurants



Retail stores



Convenience stores



Quick-service
restaurants (QSRs)



Gas stations
& fuel retail

The retail and restaurant industries have been forced to transform to meet consumer demands, supply chain challenges, and labor constraints. Underlying factors driving this transformation are the rise of e-commerce, growing competition, price-conscious consumers, and increased costs — as of 2022, online sales accounted for 20% of all retail sales.

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, convenience stores, gas stations, fast-casual and quick-service restaurants — have improved operational efficiency and provided consumers with an enhanced overall experience while maintaining profitability.

While restaurants and QSRs face different market forces, increasing numbers are accelerating their adoption of edge computing and AI to streamline processes, cut costs, and gain valuable insights into their customers and operations.

A recent GlobalData study into edge computing in the retail and restaurant industries revealed, in the next 24 months:¹

- 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.

Edge AI applications

Intelligent stores and QSRs

- **Autonomous shopping:** Automate checkout with self-service, power nano store technology, support smart cabinets to automatically order stock as it leaves the shelf.
- **Store analytics:** Provide real-time alerts for stock-out, heat maps for customer traffic, and optimize queue/wait time. Forecast staffing requirements and product demand based on shop floor location.
- **Asset protection:** Identify and intercept ticket switching, mis-scanning, and employee theft.
- **Drive thru:** Offer voice order taking, manage wait times, and offer advanced multi-modal recommendations.
- **Kitchen:** Ensure production quality, order bagging accuracy, sanitation compliance, and decrease product waste.

Omnichannel management

- **E-commerce/digital:** Use AI and analytics to provide customers with a unified shopping experience. Offer personalized recommendation systems and dynamic pricing.
- **Conversational AI:** Provide customers with support through NLP/chatbots, virtual assistants, and conversational commerce.
- **Cybersecurity:** Guard against cybersecurity with live analysis of threats including fraud detection.

Intelligent supply chain

- **Forecasting:** Increase speed and accuracy of forecasting, including demand forecasting.
- **Smart warehouses and distribution centers:** Optimize the supply chain throughput with loading dock intelligence and data capture, robotics pick and place, smart forklifts, and package lifecycle tracking.
- **Routing optimization:** Reduce logistical burden with route and last-mile delivery optimization.

¹ GlobalData, 2021, Retail in 2021 and beyond: Trends and solutions with edge computing

Edge AI for manufacturing, supply chain, and transportation



Automotive



Industrial



Aerospace & defense



Food & beverage



IT



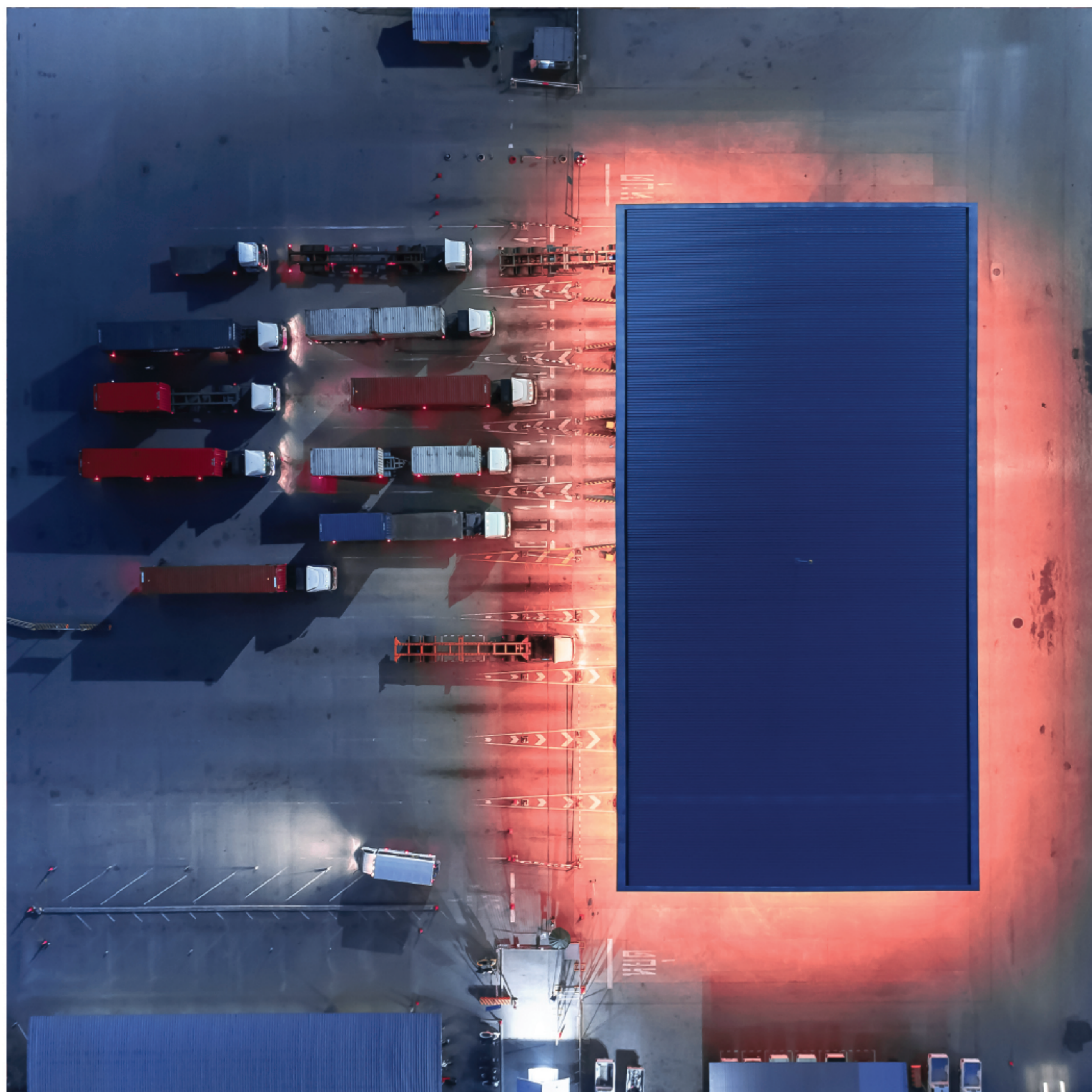
Supply chain



Transportation

Technology is at the heart of modern manufacturing, supply chains, and transportation, allowing firms to confidently tackle an array of hurdles in highly competitive markets. Manufacturers are increasingly reliant on technological advances as they strive for greater profitability and sustainability. Market pressures include increasing costs, reducing environmental impact, global competition, and labor shortages — all of which make manufacturing complex and costly. At the same time, customers are becoming more informed, demanding higher quality, faster lead times, and enriched customer experiences.

To remain competitive, manufacturers, logistics companies, and transportation providers are turning to edge computing. IoT devices, ML algorithms, deep learning, AI, and automation are being used to streamline design and delivery processes, making them faster and more efficient. Edge AI helps manufacturers optimize their manufacturing processes, improve production quality, speed, and reduce production downtime and wastage.



Research by global market intelligence firm IDC¹ found:

54% of manufacturers are looking to expand their use of IoT applications.

53% of manufacturers are looking to expand their use of process automation.

53% of manufacturers are looking to expand their use of inventory management.

50% of manufacturers are looking to expand their use of predictive maintenance.

Edge AI applications

Quality control automation: Use computer vision and machine learning to inspect products on the production line and detect any defects or inconsistencies. Automate quality checks, such as measuring dimensions, checking material defects, and verifying product conformity.

Production line diagnostics: Monitor production line devices and performance and identify any bottlenecks or malfunctions that can lead to reduced output.

Predictive analytics: Use live data from connected devices to make accurate production decisions to drive efficiencies and optimize production output. Leverage AI-enabled sensors, robots, drones, and other devices to monitor production lines for any potential safety risks and maintenance issues.

Robotics: Leverage cameras and deep learning models to guide robotics actions — e.g., picking up and sorting objects.

Worker safety, ergonomics, and productivity: Use Intelligent Video Analytics (IVA) to identify safety and health concerns before risks happen. Identify production bottlenecks in real time.

¹ IDC, 2021, Edge Computing: Services for Manufacturing

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Edge AI for healthcare providers



Hospitals



Home care



Emergency
medical services



Clinics and
medical offices



Nursing and
hospice homes

The digital transformation of the healthcare industry is a constant process. With high quality standards, large investment requirements, multiple layers to decision making processes, and system failure not being an option, the sector is often cautious in adopting new technologies. Facing increasing pressures from an ageing population, rising costs, and talent shortages, healthcare is looking to technology to boost care effectiveness, increase care flexibility, and improve care efficiency.

Technology is bringing healthcare closer to the patient and creating new opportunities for collaboration and data sharing between health providers. This leads to greater integration of care pathways, improved coordination of services, and better access to medical data, which helps inform decisions. AI-enabled solutions support more accurate diagnoses, personalized treatments, and faster medical interventions. Automation solutions are making it easier for health workers to access data, manage workflow, and communicate with patients. Telehealth solutions are reducing the cost of care while making it more accessible in remote areas.

This transformation in healthcare is being driven by edge computing, eliminating the need for large network bandwidth with the computation performed locally and on IoT devices. In addition to the speed and logistical efficiencies, edge computing offers much-needed security and privacy safeguards, with data no longer flowing through centralized cloud networks.

- Healthcare facilities have been among the top targets for ransomware attacks since the pandemic.¹
- 30% of the world's data is healthcare, growing by 36% every year.²
- Forecasts predict there will be 1.1 million edge AI appliances in the medical imaging/laboratory & life science sector by 2025.³
- \$11.6 billion will be spent on AI software in healthcare in 2026.³

Edge AI applications

Drug discovery: Virtually model millions of molecules and screen hundreds of potential drugs at a time, reducing costs and speeding time to solution with accelerated computing.

Medical imaging: Quickly read images, calculate measurements, monitor changes, and identify urgent findings to optimize workflows and enhance patient care.

Genomics: Accelerate genome analysis in population and cancer genomic studies, identify rare diseases, and bring tailored therapeutics to market faster, advancing the journey to precision medicine.



¹ Deloitte, 2021, Digital transformation

² The OECD Forum Network, 2021, The importance of increasing access to high-quality health data

³ Omdia, Moving AI from Idea to Execution, Power of 2



Edge AI for energy and telecommunication providers



Renewable energy



Electrical power



Oil and gas



Telcos & ISPs



Consumption points

In recent years, energy and telecommunication service providers have been at the forefront of emerging technologies. From advancements in renewable energy sources such as solar, wind, and hydro to 5G networks that promise faster speeds, these organizations constantly innovate to keep up with customer demand and industry regulations.

Energy service providers are continuing to invest in renewable, clean energy sources and smart grids, which ensure reliable power delivery, improve efficiency, and reduce costs. Providers have implemented millions of smart meters to collect insights into energy consumption and enhance customer experience. The smart, modern, distributed architecture offers robustness and actionable intelligence to enable a fast and efficient response to ever-changing consumer demands – with providers leveraging edge AI and IoT to take their electricity management to the next level.

Telecommunication providers are modernizing their networks to overcome complex challenges, including simplifying network operations and improving flexibility, efficiency, reliability, and scalability while reducing latency and enhancing application response times. Edge computing enables providers to optimize and integrate workloads – its distributed nature enhances availability and resiliency, allowing for local data processing and storage closer to users and devices. In an outage, functions and applications can be backed up by nearby edge cloud sites, minimizing downtime.



Edge AI applications

Smart metering:

Use intelligent sensors to detect power outages and anomalies in real time, optimize energy usage, and reduce operating costs.

Network monitoring:

Leverage AI-enabled analytics to monitor network performance, identify security threats, and detect potential system issues or outages.

Data optimization:

Utilize AI-enabled algorithms to analyze customer data and provide insights on usage trends and preferences.

Network optimization:

Leverage AI-enabled analytics to optimize network performance, reduce latency, and improve overall efficiency.

Proactive network maintenance:

Utilize AI-enabled predictive analytics to detect potential issues and recommend maintenance strategies before they become a problem.

24%

of US electricity currently comes from renewables.¹

5%-15%

energy savings can be made through implementing effective Energy Management Information Systems.²

84%

of utility providers are implementing or planning to implement edge IoT.³

¹ U.S. Energy Information Administration, 2022, Electric Power Monthly

² Wall Street Journal, By IndustryWeek in collaboration with Emerson

³ Forrester, 2019, IoT Deployment is Driving Analytics to the Edge

Edge AI solutions

When deploying 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.

Lenovo and NVIDIA edge AI world-changing technologies are driving innovations across all industries

Computing:

Lenovo and NVIDIA offer a breadth of purpose-built and edge computing solutions to power industry-leading performance, security, and manageability for your organization.

Servers and storage:

Lenovo ThinkEdge clients and servers, along with 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 organizations 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, certified to deploy 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.

Lenovo ThinkSystem and ThinkEdge solutions enabling 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 all industries.

Lenovo ThinkSystem Servers (such as the SR630 V3), 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), 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 device management application expand options and improve control, from far edge to core:

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

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EDGE AI SOLUTIONS FOR EVERY INDUSTRY

AI SOLUTIONS FROM ISVs & TECHNOLOGY PARTNERS

Customer Experience Examples

Retail Experiences

Customer Services

Accurate Diagnoses

Customer Safety

Operational Performance Examples

Traffic Management

Inventory & Forecasting

Loss Prevention/
Fraud Detection

Automation

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. vSAN

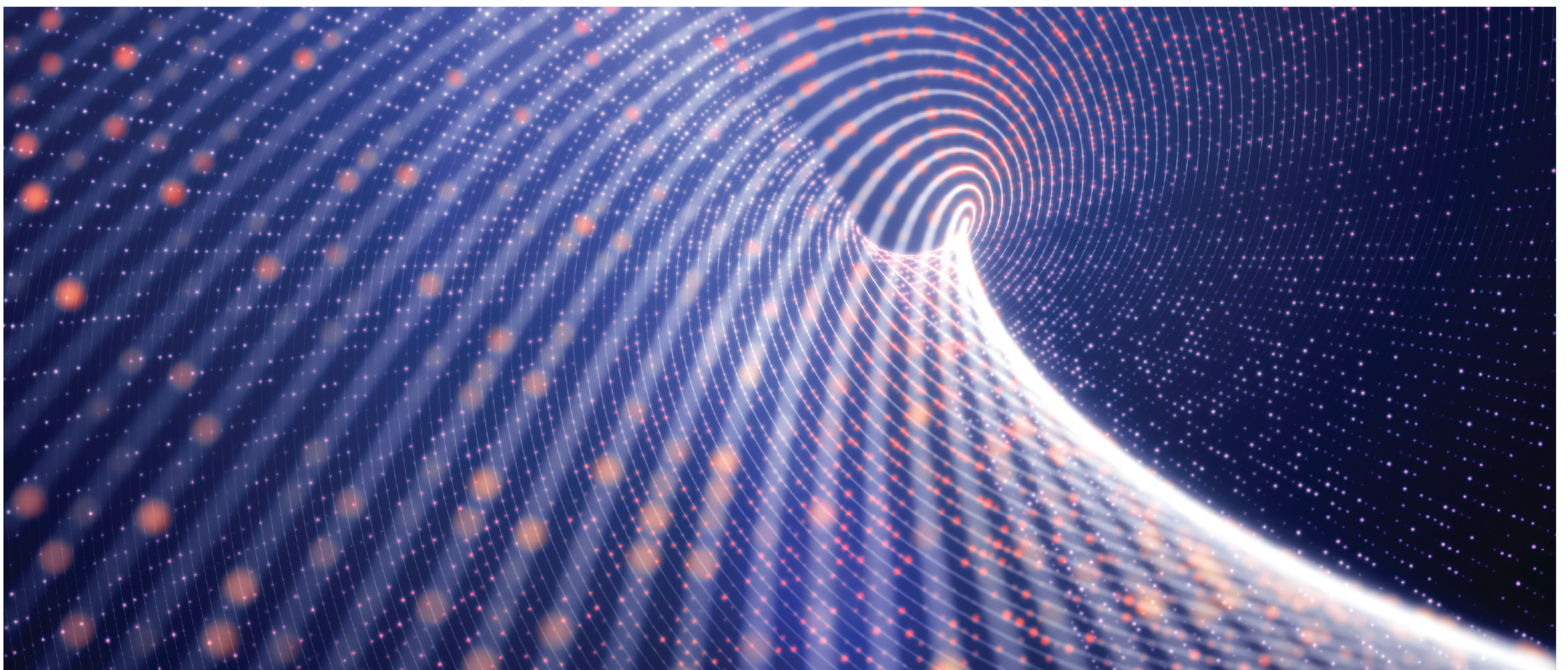
Management
e.g. Lenovo XClarity, VMware vSphere

Lenovo Server & Edge Technology

ThinkEdge Clients &
ThinkStation Workstations
e.g. SE70, P360

ThinkEdge Servers
e.g. SE350, SE450

ThinkSystem Servers
e.g. SR630, SR645



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The Lenovo advantage powered by NVIDIA

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.

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Edge AI in action

Bringing next-generation 5G technology to the old world — edge AI in a smart city

A recognized telecommunications hub, Barcelona is one of the first European cities to strive to improve the lives of their citizens through data-driven smart city technologies. To do this, Barcelona realized that 5G networks would support the smart city, removing the need for bulkier, more expensive fixed wiring.

In 2019, a consortium of companies, including Lenovo, was awarded the development of a 5G pilot in the Barcelona metropolitan area to test smart innovative solutions across education, industry, commerce, tourism, transport, and safety.

While 5G communication presented the Barcelona pilot with vast opportunities by limiting the need for excessive wiring and supporting the multiple IoT and edge applications it takes to run a smart city, it also came with challenges. Because IoT devices and smart grids generate a larger quantity of data, the mobile network operators (MNOs) were facing additional pressure to improve bandwidth and latency. The project scope involved looking for new ways to optimize the infrastructure, reduce costs, and generate new sources of revenue.

Cellnex and the consortium knew they needed to move network capabilities from centralized data centers to edge devices to keep the pilot running smoothly, but the question, "How?" remained. That's when the consortium looked inward to their member, Lenovo. With innovative edge computing, Lenovo designed a solution to alleviate the pressure on MNOs using a multi-access edge computing (MEC) network architecture.

To bring the platform together, Lenovo is employing a suite of products from the ThinkEdge hardware family and automation software solutions. Now, the system can rapidly deploy, optimize, and manage the cloud infrastructure of the communication service providers on edge servers, dedicated bare metal servers, containers, and virtual machines.

Lenovo automation software solutions combine the advantages of the public cloud, including speed, scalability, flexibility, and high velocity of service, with those of private clouds, such as data protection and security, to offer the seamless integration needed to take advantage of the full potential that 5G communication has to offer. The system also includes support for Kubernetes, Red Hat OpenShift, OpenStack, and VMware Cloud Foundation — truly making it a smart, open, modular, future-proof, and flexible solution for the pilot.

Cellnex and Lenovo will continue to push ahead by combining Lenovo's edge computing with other services that effectively will create an open innovation ecosystem to fuel transformation across daily experiences in Barcelona.

"We have been working with Lenovo in open innovation to define the edge computing product with faster response from the network and more devices connected."

Jose Antonio Aranda — Global Director for Innovation & Product Strategy, Cellnex

[Learn more about the success story here.](#)

Automating the factory floor with robust edge servers — edge AI in manufacturing

Strauss Coffee, one of the top ten coffee companies in the world, relies on an extensive supervisory control and data acquisition (SCADA) system to keep factory operations running. This comprises supervisory systems connected to plant machinery and human-machine interfaces (HMI) through programmable logic controllers (PLCs) and other industrial automation sensors.

The supervisory systems collect, aggregate, and visualize equipment data in graphical dashboards, enabling operators to monitor, control, and optimize production, operating in a challenging environment with high temperatures and dusty conditions.

After trialing many systems and running into system failures due to overheating, Strauss Coffee selected Lenovo ThinkSystem SE350 edge servers for their rugged, compact design and high temperature tolerance.

Today, the Lenovo ThinkSystem SE350 edge servers are an essential part of Strauss Coffee's SCADA system. Connected to 8,000 equipment sensors, the servers control more than 42,000 digital input/output (I/O) devices, collecting data on machine state, error codes, temperature, humidity, pressure, and more.

"We're delighted with the Lenovo ThinkSystem SE350 servers. As well as being more robust, secure, and easier to maintain than our old supervisory computers, they deliver more compute and storage performance. This helps keep our mission-critical SCADA system and manufacturing operations running smoothly."

Aurelian Mester — IT Manager, Strauss Coffee

[Learn more about the success story here.](#)

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Edge AI deployment considerations

As innovation revolutionizes the modern world, 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. Organizations 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 analyses are critical stages in all technology asset investments. For edge computing, organizations 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 is at a premium in most business environments. 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:

Organizations 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. Organizations should enforce privacy and security measures in deploying their network, and edge technology to ensure compliance with industry regulations and data protection policies.



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.

Lenovo and NVIDIA

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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