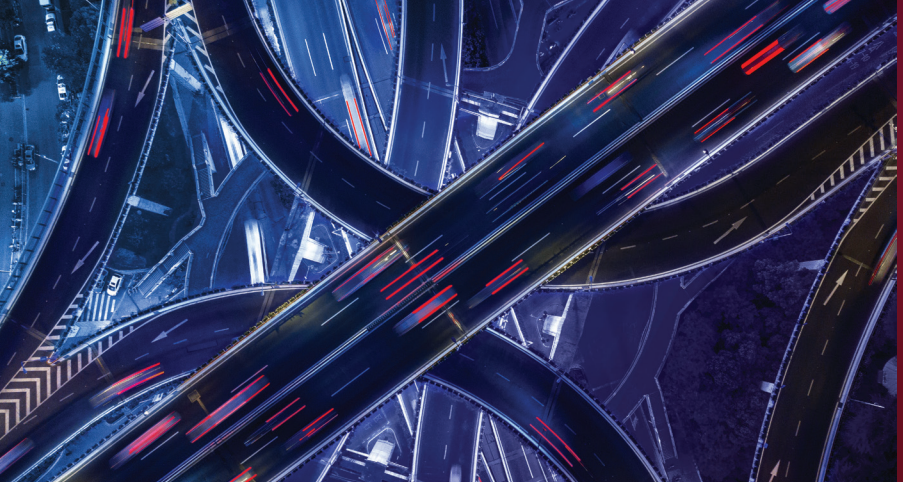

Powering the transformation of smart spaces & cities with edge AI

LENOVO + NVIDIA® SOLUTION BRIEF

Paving the way for an efficient future, building smarter spaces and safer places

The situation

Overcoming complex challenges through automation

Public spaces and cities face unprecedented challenges. With rising costs, growing populations, increased usage, and the demand for technology-optimized human expediences, organizations are under pressure to improve operational performance — leading to the rise of smart spaces. Smart spaces are physical environments benefiting from smart infrastructure and automation. They are prevalent across many industries, including retail, manufacturing, airports, stadiums, and cities.

Organizations are navigating an increasingly complex demand for technology-enabled solutions, embracing innovative applications to scale operations and developments, enhance efficiency, improve user interactions, and strengthen safety and security. As retailers seek deeper insights to improve customer experiences; manufacturers search for faster, cost-effective, superior-quality production; airports and stadiums look to minimize delays while boosting customer satisfaction and safety; and expanding cities aim to optimize roadways, energy usage, waste disposal, make neighborhoods more livable, and enable healthier lifestyles; smart spaces are seen as the answer.

With capabilities to empower smarter, safer, and more efficient spaces, edge AI is a formidable force in transforming the dynamics of spaces through AI-powered automation. The demand for spaces to operate more flexibly, intelligently, and autonomously necessitates technology adoption, such as Vision AI, which leverages sensor infrastructure to create real-time actionable insights. With Vision AI, buildings are smarter, retail is increasingly contactless and seamless, manufacturing is safer and more streamlined, and roads and intersections are optimized for traffic flow.

The challenges facing spaces and cities

Industries are facing mounting challenges amid growth, competition, technological advancement, and urbanization:

Retail

- Only 32% of retailers forecast growth in operating margins.[1]
- The retail industry has experienced record store closures in recent years.[2]

Manufacturing

- 94% of companies are adjusting their operational processes for growth.[3]
- 87% believe smart technology will be crucial for productivity and prosperity.[3]

Aviation

- With passenger numbers returning to pre-pandemic levels, airport operations and security pressures are back at an all-time high.[4]
- U.S. domestic flight on-time arrival rates are stuck between 75–80%, with 1–2% cancellations and domestic airports are reporting 40–50 million bags mishandled per quarter.[5]

Rail

- Demand for rail is expected to increase 2.7 times by 2050.[6]
- In India, the world's busiest rail network, passengers lost a cumulative 24 years due to train delays in just 7 months of 2022.[7]

Cities

- 56% of the world's population lives in urban areas (4.4 billion people), a statistic expected to double by 2050.[8]
- Cities represent two-thirds of global energy consumption and over 70% of greenhouse gas emissions.[8]
- The average U.S. motorist spent 51 hours in traffic in 2022.[9]

These intensifying pressures are leading to the rise of smart spaces across all industries.

[1] Deloitte, 2022, 2022 retail industry outlook: The pandemic creates great opportunities for the great retail reset
[2] Retail Insight Network, 2022, Retail Revolution: a look at the merchant benefits of Smart Retail
[3] PwC, 2020, Annual Manufacturing Report 2020
[4] IATA, 2023, Air Travel Growth Continues in March
[5] Bureau of Transportation Statistics, 2023, Air Travel Consumer Report: March 2023 and 1st Quarter 2023 Numbers
[6] International Energy Agency, 2019, The Future of Rail: Opportunities for energy and the environment
[7] The Times of India, 2022, In 7 months, Railways lost 24 years due to train delays
[8] The World Bank, 2023, Urban Development
[9] Forbes, 2023, These Are the Cities Where Motorists Lose the Most Time and Money Sitting in Traffic

The growth of smart spaces

$274 billion will be spent on edge solutions in 2025.[10]

Juniper Research predicts a 150% increase in smart buildings worldwide, from 45 million in 2022 to 115 million by 2026,[11] growing at an annual rate of over 25%.[12]

88% of retailers either have deployed edge computing or plan to within a year.[13]

The AI manufacturing market size was US$1.82 billion in 2019 and is projected to reach US$9.89 billion by 2027, at a CAGR of 24.2%.[14]

Data Bridge Market Research forecasts a CAGR of 46.3% for the period of 2022–2029 for AI in the aviation industry, reaching almost US$10bn by 2029, with surveillance and flight operations among the main use cases.[15]

The digitization of services has reduced operating costs for 85% of cities in the EU,[16] while in Shanghai, smart spaces have helped reduce crime by 30%.[17]

Implementing IoT smart devices in spaces and cities has proven to reduce emergency response times by 20–35%, commuting by 15–20%, and emissions by 10–15% with traffic signal optimization.[18]

The smart spaces

- Educational & Corporate Spaces
- Healthcare Facilities
- Commercial & Recreational Spaces
- Transport & Logistics Hubs
- Industrial & Business Spaces
- Stadiums/Arenas
- Urban Infrastructure & Smart Cities
- Farms & Agriculture Environments
- Airports
- Ports (Ships)
- Trains
- Traffic Lights

Example of a Smart City

Traffic Management
Vehicle Intrusion
Congestion Detection
Illegal Stopping/Parking
Vehicle Type Reports
Pedestrian Detection
License Plate Recognition
Vehicle Counting
Multimodal Data Collection

Parking Management
Congestion Detection
Parking Bay Occupancy
Illegal Parking
Parking Vehicle Type Counting
ANPR Time in Area & Overstay
ANPR Watchlist
Parking Stall Analytics
License Plate Detection

Curbside Management
Vehicle Counting
Number Plate Detection
Congestion Detection
Vehicle Type Detection
ANPR Watchlist
Illegal Parking
Electric Vehicle Preference
Automatic Payments

Toll Management
Number Plate Detection
Automatic Payments
Vehicle Counting
ANPR Watchlist
Vehicle Type Detection
Congestion Detection
Illegal Stopping/Parking
Ingress/Egress Analytics

[10] Statista, 2023, Edge computing market revenue worldwide from 2019 to 2025
[11] Smart Buildings Magazine, 2022, Cloud vs. Edge AI: What's best for your facility?
[12] Bloomberg, 2022, Smart Building Market to Hit $570.02 Billion by 2030: Grand View Research, Inc.
[13] IDC, 2022, IDC FutureScape: Top 10 Predictions for the Future of Digital Infrastructure
[14] Fortune Business Insights, 2022, Artificial Intelligence (AI) in Manufacturing Market
[15] Data Bridge Market Research, 2022, Global Artificial Intelligence in Aviation Market — Industry Trends and Forecast to 2029
[16] OECD, 2020, Smart Cities and Inclusive Growth
[17] BBC, Safe cities: Using smart tech for public security
[18] McKinsey & Company, 2018, Smart cities: Digital solutions for a more livable future

Redefining the landscape of smart spaces with Lenovo and NVIDIA edge AI

In partnership with NVIDIA, Lenovo edge AI solutions empower smart public and business spaces to improve process effectiveness and operations. With computing power at the edge, AI can run locally, automating and improving processes while benefiting from low-latency central control, delivering powerful computing when and where it is needed.

Lenovo's AI-ready ThinkEdge portfolio powered by NVIDIA GPUs comprises purpose-built devices designed to be discretely connected on-premises. The NVIDIA AI Enterprise Suite, which includes NVIDIA Metropolis for vision AI, runs on Lenovo's infrastructure, accelerating the speed at which developers can build and deploy AI applications. The rugged, fully integrated AI solution delivers best-in-class availability, security, and scalability with enterprise-level manageability and high-performance data analytics. These innovative solutions help smart spaces harness real-time, actionable insights, optimize operations, and augment experiences for workers and the community, making environments safer, scalable, and sustainable.

Edge computing enables smart spaces, buildings, and cities on every continent. And this is only the beginning. A recent Verdantix study revealed 45% of real estate and facilities executives view edge computing as a significant consideration for future developments.[19] With distributed ruggedized technology, free from the shackles of standalone data centers, Lenovo ThinkEdge AI solutions provide the complete platform to help start or accelerate an edge AI journey.

An industry-leading edge AI infrastructure solution

Optimized performance at the edge: Personalized end-to-end GPU-accelerated solutions from Lenovo and NVIDIA offer fast insights to drive customer experience, productivity, and performance improvements.

A trusted partnership: Lenovo and NVIDIA combine core competencies to power the AI journey for world-leading organizations. Through a strategic partnership, Lenovo and NVIDIA collaborate on R&D initiatives, AI Labs, and AI Centers of Excellence, helping customers at every stage of their technology adoption process.

Easy and secure edge management: Lenovo and NVIDIA provide complete, pre-validated, edge-optimized infrastructure with record-setting performance and low total cost of ownership (TCO). The integrated solution enables the user-friendly and secure operation of AI applications with existing infrastructure management frameworks, and facilitates faster AI deployment and time to value.

Ecosystem support: Through NVIDIA partner programs, such as NVIDIA Metropolis partner program or Inception program, Lenovo customers benefit from the large and growing family of independent software companies (ISVs) investing in the most advanced AI techniques, state-of-the-art deployment platforms, and enterprise-class approach to their solutions.

Management and implementation: Lenovo Local Cloud Automation (LOC-A) offers faster ROI and insights, saving time and money — and reducing carbon footprints — by automating all the manual tasks required to get an entire edge infrastructure up and running. LOC-A operates at scale in hours, not days or weeks, as previously required. The provisioning process is simplified by using a zero-touch secure utility running on a smartphone or laptop, configuring, validating, and then onboarding the entire spectrum of Lenovo ThinkEdge clients and servers, with limited skillsets required and minimal travel needed.

And with enhanced XClarity management functionality, edge customers get an easy, one-stop management platform across all of Lenovo's edge devices. They no longer have to work in separate applications and screens to ensure their edge components are online, up to date, operating efficiently, and delivering the data needed to make important, fast business decisions.

Whether on-premises or in-cloud, customers get device management capabilities with minimal footprint but with a scalable architecture.

[19] Verdantix, 2020, Global Corporate Survey 2020: Smart Building Technology Budgets, Priorities & Preferences

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Edge AI in action: Streamlining processes and prioritizing experiences

Optimized traffic management: Analyze real-time data to improve traffic flow and predict collisions, reducing congestion in smart cities.

Efficient transit hub management: Employ real-time monitoring, predictive analysis, and automation in airports and across transport networks to increase transit hub efficiency, minimize passenger delays, and improve movement.

Industrial automation: Enable optimization in factories and manufacturing operations with benefits from predictive maintenance, and quality control with anomaly detection.

Intelligent parking operations: Provide accurate availability updates and navigation to vacant spots, streamlining parking management and saving parking time.

Revolutionizing hospital operations: Optimize hospital workflows, patient care, and surgical procedures, improving both health outcomes and operational efficiency.

Adaptive street lighting: Adjust lighting conditions in response to natural light levels and occupant preferences, creating comfortable and energy-efficient environments.

Smart retail operations: Enable frictionless shopping experiences with cashier-less checkout, personalized recommendations, and live inventory management.

AI-driven quality control: Help detect defects, identify anomalies, and ensure product consistency in factories, significantly improving quality control.

Efficient logistics and package sorting: Boost productivity, speed up delivery processes, and enhance customer satisfaction.

Intelligent waste management: Monitor and manage waste disposal and recycling systems more effectively, leading to cleaner and more sustainable urban environments.

Smart agriculture: Improve crop yields and minimize the use of resources such as water and fertilizers, resulting in more sustainable agriculture practices.

Robotic process optimization: Integrate edge AI-driven robotics into manufacturing workflows to automate repetitive tasks and enhance precision and productivity across various sectors.

Real-time event insights: Provide spectators with real-time data, live analysis, and insights to enhance the enjoyment and understanding of a performance.

Interactive event experiences: Monitor crowd reactions and deliver real-time interactive experiences, such as polls, contests, and trivia, to add spectator value and drive fan engagement.

Immersive tours: Provide personalized recommendations and information about areas, buildings, and exhibits, enhancing cultural and educational experiences.

Enhanced accessibility: Actively assist the movement of blind individuals around a space or city and monitor accessibility needs to optimize the deployment of ramps, elevators, and other aids to support mobility.

Strengthening safety and security

Advanced workplace safety: Monitor hazardous areas and identify safety risks in real time, preventing accidents and enhancing workplace safety.

Secure spaces management: Observe crowd flow and promptly alert authorities of abnormal activities to ensure safer environments with access control, license plate detection, and more.

Proactive airport security: Automate airport security processes, including threat detection, crowd monitoring, and perimeter protection, enhancing overall airport safety and security.

Crowd safety in large-scale gatherings: Harness real-time crowd density monitoring and proactive crowd management, enhancing safety measures and improving experiences at large gatherings, such as stadiums and airports.

Example of a Smart Airport

Lenovo and NVIDIA edge AI: A solution stack for smart spaces

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 accelerated by NVIDIA 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, including Omniverse for simulation and Metropolis for vision AI. NGC simplifies building, sharing, and deploying software, allowing smart spaces 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.

Use cases across Smart Spaces

- Educational & Corporate Spaces
- Healthcare Facilities
- Industrial & Business Spaces
- Stadiums/ Arenas
- Urban Infrastructure & Smart Cities
- Farms & Agriculture Environments
- Airports
- Ports (Ships)
- Trains
- Traffic Lights

AI Capabilities

- Vision AI for Safety
- Vision AI for Operational Efficiency
- Object Recognition
- Classification
- Real-Time Detection

NVIDIA AI Tools

- **Metropolis and Inception** ISV Ecosystem
- **Pre-Trained** AI Models on NVIDIA NGC
- **TAO Toolkit** for AI model training
- **DeepStream** for optimized inference
- **Metropolis Microservices** for cloud-native apps
- **Fleet Command** for edge deployment management
- **Omniverse** for synthetic data generation

GPU-Accelerated 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, P3
- ThinkEdge Servers — e.g. SE360 V2, SE450
- ThinkSystem Servers — e.g. SR630, SR645

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Lenovo ThinkEdge and ThinkSystem 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 every space.

Lenovo ThinkEdge SE70:
Lenovo ThinkEdge clients (such as the SE70 shown) combine rugged utility and versatility for remote use at the far edge in back-office locations or street, telecom, and outdoor cabinets.

Lenovo ThinkEdge SE360 V2:
Ruggedized, resilient Lenovo ThinkEdge servers (such as the SE360 V2) offer AI-enabled performance and robust security for the most challenging environments. With a minimal acoustic footprint and optimal cooling, ThinkEdge servers drive agility, intelligence, and sustainability at the edge.

Lenovo ThinkEdge SE450:
Is an advanced processor-based server with a 2U height and short depth case that can go almost anywhere. Its rugged technology can handle continuous operating temperatures from 5°C to 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.

Why Lenovo and NVIDIA

Working in partnership with NVIDIA, Lenovo is developing world-changing technologies to enable solutions across all industries and use cases. By designing, engineering, and building the world's most complete portfolio of innovative, AI-ready devices and infrastructure, Lenovo and NVIDIA are leading an Intelligent Transformation — to create better experiences and opportunities for millions of customers worldwide.

To find out more, visit https://www.lenovo.com/nvidia-edge-ai/.