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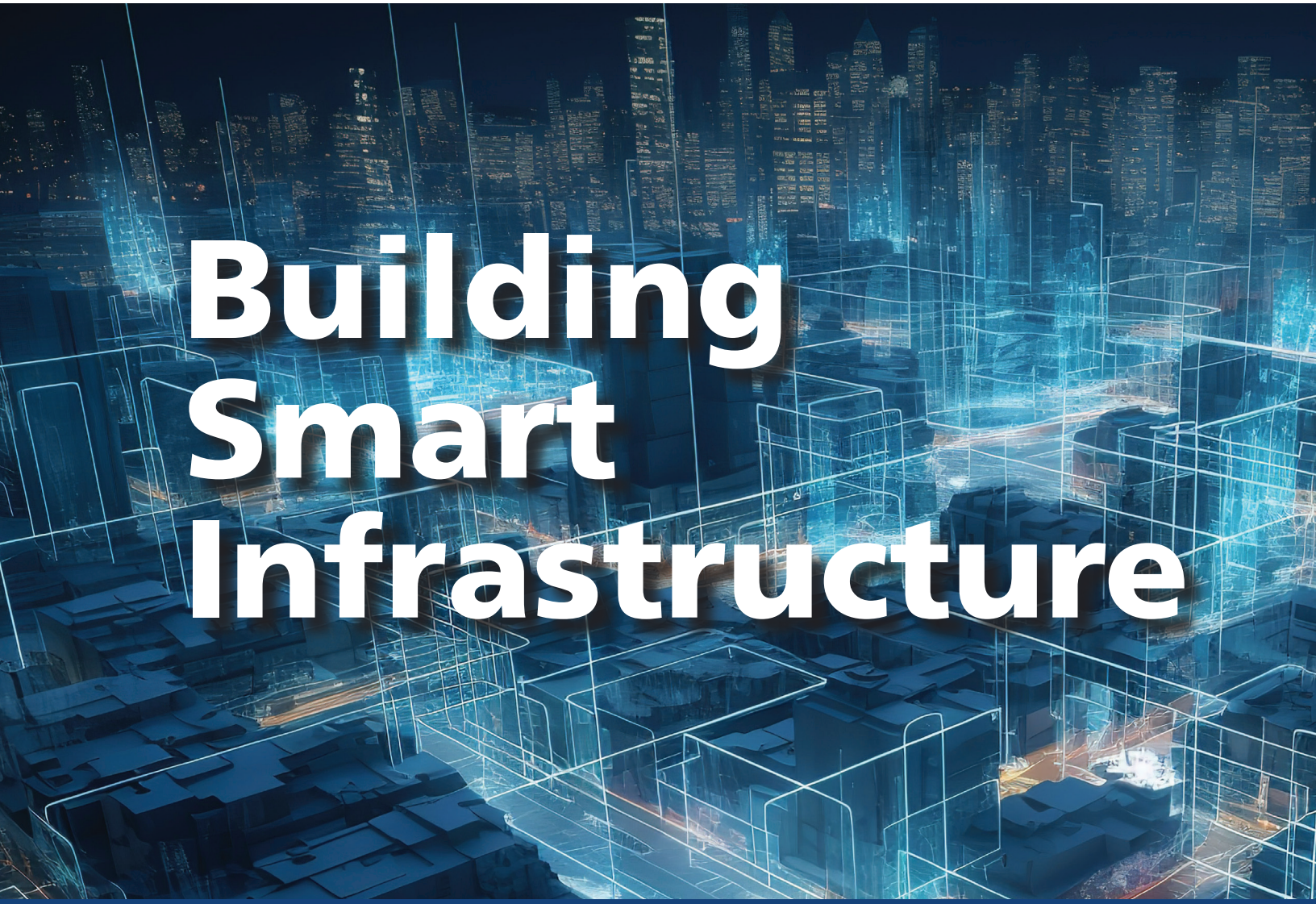

Building Smart Infrastructure

NVIDIA and Lenovo technology bring intelligence to buildings and other infrastructure.

by Cadalyst Staff

» *Cover art: VisualMarketplace/stock.adobe.com.*

Building Smart Infrastructure

NVIDIA and Lenovo technology bring intelligence to buildings and other infrastructure.

This is the second of a six-part special feature covering data management, digital twins, AI, IoT, and other technology for AEC designers, engineers, and owners. This issue focuses on building smart infrastructure using digital twins and related technology. In future articles, we'll be digging into other topics, such as reality capture, real-time tracing, and virtual reality.

By Cadalyst Staff

In our previous article, we discussed the challenges of managing large datasets associated with architecture, engineering, and construction (AEC) projects. The data deluge, which begins early in most projects and continues throughout project lifecycles, requires AEC teams to be equipped with proper hardware and related technology to manage the large datasets.

In this article, we'll explore how technology can be used to develop intelligent buildings and infrastructure. With the wealth of data available to infrastructure professionals, teams are using this information to build ever-growing intelligence into buildings, traffic management systems, airports, and entire cities.

Infrastructure Data Throughout Project Lifecycles

Historically, building and infrastructure projects were considered essentially complete once construction was done. Owners handled operations, maintenance, and record-keeping activities, while design and construction information was generally filed away and rarely accessed.

» ***Digital twins of industrial warehouses can be used to simulate, test, and optimize robotic fleets at scale. Image source: NVIDIA, Accenture, KION Group.***

In the digital age, this approach has been superseded by more persistent building information modeling (BIM) and digital twin workflows that enable teams to apply and exchange information throughout project lifecycles.

Ever-expanding data sources now provide cradle-to-grave value for infrastructure projects. In addition to geometric design information contained in CAD models, a wide variety of construction data, operations and maintenance (O&M) information, and other metadata provide intelligence to infrastructure systems. AEC teams build digital twins — virtual representations of physical products, processes, and facilities — to help plan, design, and build projects, as well as operate and maintain them after construction.

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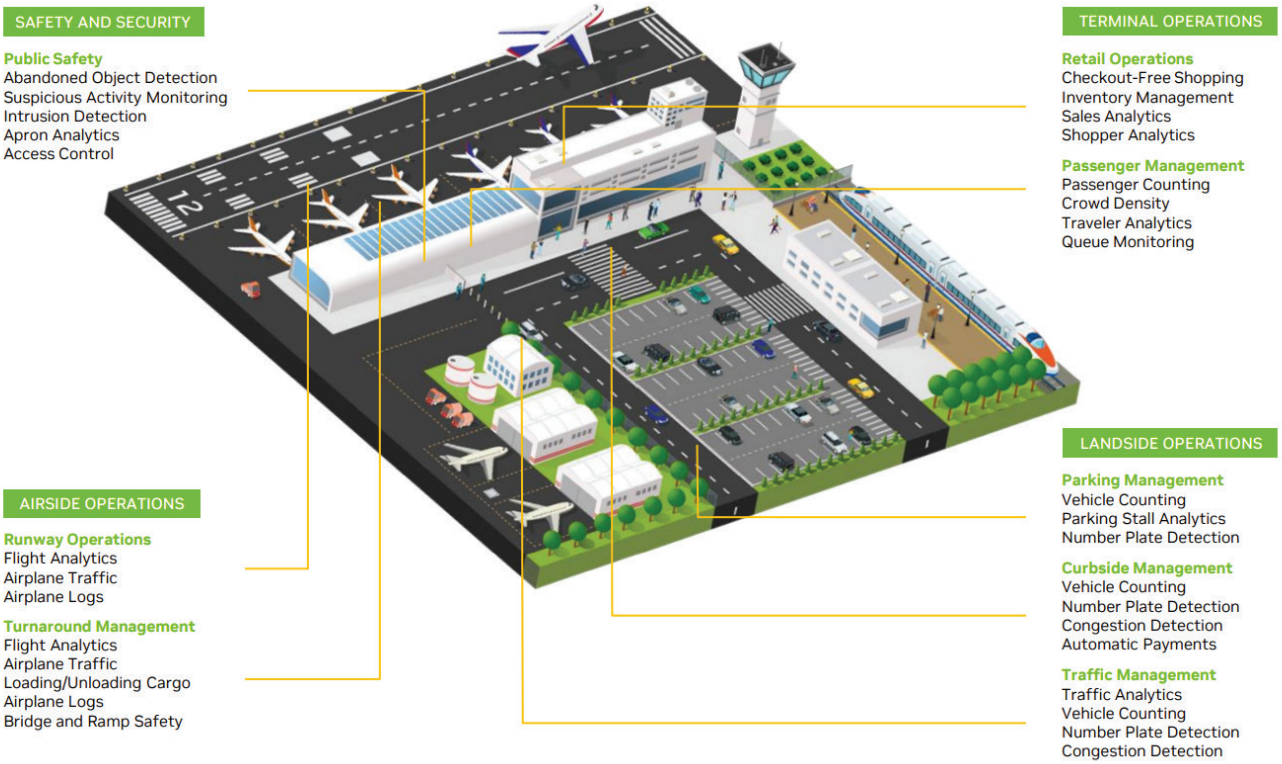
Early AEC applications of BIM and digital twins focused on commercial and industrial buildings. As facility owners, designers, and builders found that 3D models could be enriched with a wide variety of data such as equipment specifications, photographic imagery, sensor and IoT data, cost and schedule information, and O&M records, interest in BIM grew rapidly.

Digital twin applications followed, as owners and AEC teams recognized value in creating real-life digital models of their designs and updating the models during and after construction. Building equipment such as pumps and motors could be annotated with metadata to monitor equipment and guide maintenance and replacement. Simulations could be performed to optimize operations and workflows.

Real-world Applications

Lenovo ThinkStation and ThinkPad P Series Workstations with NVIDIA RTX™ professional graphics are well suited for AEC professionals working on intelligent infrastructure projects. This combination harnesses the power and performance of NVIDIA RT Cores and Tensor Cores to deliver real-time high-fidelity visualization. By drawing on the large GPU memory offered by NVIDIA RTX professional graphics, teams can smoothly work with massive 3D models and scenes and quickly iterate to create compelling renderings.



» Airports have used AI-enabled video analytics solutions to improve operations and minimize disruptions to passengers. Image source: NVIDIA.

Digital twins have also added intelligence to airports. Accessing video camera and sensor data, intelligent systems have improved airplane turnaround efficiency, parking management, security, and overall airport operations.

Underlying Technology That Makes it Work

A wide variety of technologies work together to make smart buildings and infrastructure possible. Along with basic CAD modeling and data gathering tools such as LiDAR, reality capture devices, and sensors, a plethora of high-powered hardware, software, and solutions are needed to support smart infrastructure. Technologies such as AI, automation, and robotics play key roles.

Within AI, AEC practitioners should become familiar with the terms generative, agentic, and physical AI. To date, most AI has been generative AI, which enables interaction with industrial data and systems in natural language. The next frontier of AI is agentic AI, which uses sophisticated reasoning and iterative planning to autonomously solve complex, multi-step problems. Expanding further, physical AI (sometimes called generative physical AI) helps autonomous systems such as robots, autonomous vehicles, and smart spaces perceive, understand, and perform complex actions in the real (physical) world.

"We are integrating AI with the world around us, and the manifestation of that is areas such as robotics and autonomous vehicles," said Sean Young, Director of AECO, Geospatial, and AI Solutions Industry Marketing at NVIDIA. "We want AI to understand the data and to be responsive, and that responsiveness is where agentic AI comes in. Agentic AI, in turn, is a step along the journey to physical AI."

» Lenovo's ThinkEdge SE455 V3 is edge-optimized for AI, Telco, and workload consolidation. Image source: Lenovo.

Improvements in data interoperability driven by open data protocols such as OpenUSD, computer graphics, generative AI, and accelerated computing, have enabled a new class of physically based and AI-enabled digital twins. OpenUSD allows developers to more easily integrate data from across ecosystems in digital twins. Developers from numerous AEC-related vendors are leveraging OpenUSD and related technologies to develop digital twin solutions for design, construction, simulation, and operation purposes. A partnership between buildingSMART International (bSI) and the Alliance for OpenUSD (AOUSD) is also exploring collaboration on standards development, expanding on bSI's work on open standards for BIM and AOUSD's standards for OpenUSD.

Built on OpenUSD, NVIDIA Omniverse enables AEC teams to collaborate seamlessly across multiple applications and orchestrate multiple technologies into digital twin workflows. Omniverse is a platform of APIs, SDKs, and services that enable developers to integrate OpenUSD, NVIDIA RTX rendering technologies, and generative physical AI into existing workflows.

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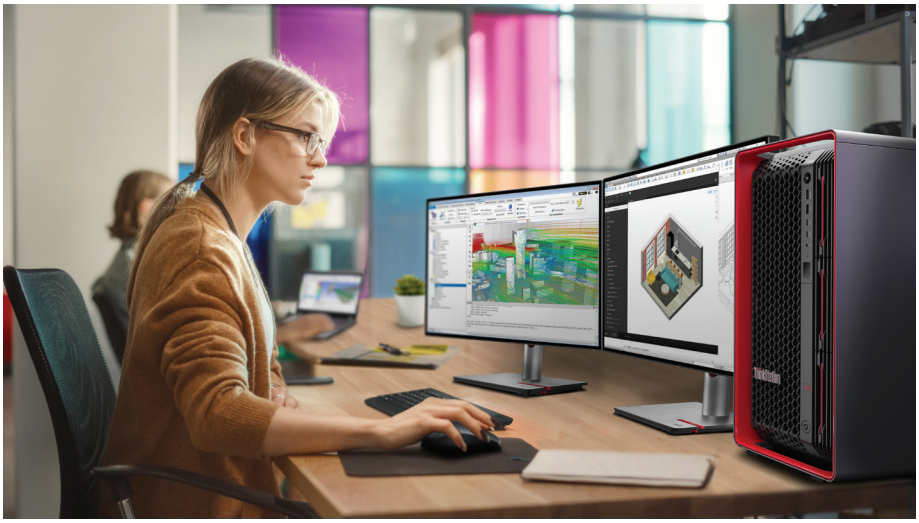
To enhance Omniverse scenes and make them photorealistic, NVIDIA Cosmos™ is a platform of generative world foundation models (WFMs), accelerated data processing, and curation tools that allows users to incorporate texture, lighting, and environmental effects. It is built to drive world model training and accelerate physical AI development for autonomous vehicles (AVs) and robots.

Behind the scenes, a combination of NVIDIA Metropolis™ and NVIDIA GPU-accelerated computing and frameworks works together to capture data using vision AI applications. Lenovo ThinkEdge clients serve as edge servers for processing multiple camera feeds. These solutions help improve operational efficiency and safety across a broad range of spaces — from city streets and airports to event centers and factory floors.

All of the software-based solutions need proper hardware to build and support smart infrastructure. According to Jon Clark, Solutions Architect for AEC/Product Design and Development at Lenovo, AEC workstations must address three main considerations: GPU, CPU, and storage. "GPU is at the top of the list because that's what primarily is supporting all of the performance and large datasets required," said Clark.



» ***Lenovo's ThinkStation PX workstation includes the latest Intel Xeon scalable dual processors and support for up to four NVIDIA RTX professional GPUs, plus high-speed DDR5 memory and PCIe storage. Image source: Lenovo.***

In our next article, we'll explore how to integrate reality capture into AEC projects. We'll explore the various hardware, software, and other solutions involved in effective reality capture. Stay tuned!

Core count is also a consideration, with multi-core processors distributing computational tasks across its multiple cores, added Clark. The parallel processing allows for faster and more efficient execution of tasks, with each core handling a separate portion of the workload.

Lenovo workstations such as the ThinkStation PX, P7, and P5 models feature dual 4th Generation Intel Xeon Scalable processors with up to 120 cores and support up to four NVIDIA RTX™ professional GPUs, each equipped with up to 48GB of memory. This combination enables real-time rendering, AI-driven simulations, and seamless manipulation of massive datasets, critical for digital twin workflows. For storage, Lenovo workstations feature the Gen 4 and 5 solid state drives (SSDs) for accessing and storing large datasets locally.

The combination of Lenovo's computing solutions and NVIDIA's graphics and software solutions has proven successful in building numerous smart buildings and infrastructure projects. Relying on this proven combination, AEC professionals can focus on their areas of expertise in building more intelligence into all types of projects. ◆

*For more than 30 years, **Cadalyst** has delivered independent, expert guidance about the software and hardware technologies that support design and engineering workflows in the AEC, civil engineering, and manufacturing markets. Visit the **Cadalyst Library** for our full line of white papers. This whitepaper was produced in cooperation between **Lenovo**, **NVIDIA**, and the editors of Cadalyst.*

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