Taking AV Systems to the Edge

10 STEP GUIDE

Security, Performance, and Scalability

Simply NUC®

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This whitepaper is designed to help you make sure your AV systems keep up, stay up and exceed expectations.

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Lessons from the front line of AV

LESSON 1

Did you hear about the fast-casual restaurant chain that wanted to get ahead of competitors by upgrading their dining experience with real-time digital signage and AV systems? They rolled out digital menu boards across 50 locations with video displays for seasonal specials, order queue systems, and live pricing to optimize operations. The goal was clear: a modern, seamless experience that would increase customer satisfaction, operational efficiency and position their brand as innovative.

At first it worked great. Lines moved faster, customers loved the visuals and upselling through video promotions increased revenue.

But as the business expanded to new locations, cracks in the technology infrastructure started to show. Some menu boards wouldn't sync new updates, causing confusion at the counter. The hardware couldn't handle real-time data feeds during peak hours, resulting in order errors. Worst of all, a single unpatched vulnerability allowed hackers to take down the entire system during a dinner rush.

LESSON 2

What about the rapidly growing retail chain that launched an ambitious plan to transform their in-store experience, creating a cutting edge, immersive environment that would drive sales and delight customers? They invested heavily in a network of digital signage to show promotions, guide customer journeys and update inventory in real-time.

At first the digital displays wowed the customers and sales soared, but soon problems emerged. Display screens at one location were behind on promotions, creating inconsistency across stores. Hardware was inefficient and couldn't process live updates, out of stock items were being promoted. Things went from bad to worse when hackers found a security gap and took control of the content management system and replaced sales banners with inappropriate messaging.

Getting AV systems to work the way you need them to is complex. Especially when you need to scale your infrastructure. Whether it is a live event, a corporate boardroom, or a network of digital signage across dozens of locations, businesses face the same challenges: delays, security gaps, soaring costs and operational and environmental efficiency.

Simply NUC solutions are built to support your AV systems at every stage, from launch to expansion, with the flexibility, power, and resilience that your environment demands.

Simply NUC and Edge Computing Solutions

With the Global Pro AV Market set to grow from $4.49 billion (back in 2024) to $11.12 billion by 2032*, the demand for fast, scalable, and resilient AV solutions will continue to rise, pushing organizations to rethink how they design, deploy, and manage their systems.

At Simply NUC, we believe Edge Computing holds the key to building a futureproof IT infrastructure.

Instead of relying on a central cloud or distant server to process everything, edge solutions handle data closer to where it is needed, right at the source. For AV environments, this shift brings major advantages: lower latency, higher security, and more reliable performance.

Simply NUC builds powerful, compact systems that put edge computing into action across AV installations of every size, complexity, and condition. Whether you are managing digital signage across hundreds of retail stores, running synchronized displays in a busy airport, or powering interactive exhibits in a museum, Simply NUC products are designed to deliver real-time performance without the lag or risks that traditional centralized models can bring.

Our solutions offer more than just processing power. They are built and customized for the realities of AV: small enough to fit behind displays or inside kiosks, rugged enough for harsh environments like hot kitchens, and flexible enough to handle live video feeds, complex display networks, and high-security content. Products like Onyx, NUC 15 Pro Cyber Canyon, and our extremeEDGE Servers™ give you the hardware to create fast, scalable, secure AV experiences. Local processing means fewer points of failure, quicker updates, and better protection against cyber threats.

*Source: databridgemarketresearch.com

STEP 1

Eliminate latency and boost performance

As consumers, we aren't prepared to wait more than a few milliseconds when we interact with a display.

A split-second delay can be a catastrophe. Whether it is a live event, a video conference, or an interactive display, audiences expect an immediate response and flawless synchronization. When audio lags behind video or devices fall out of sync, the entire experience suffers, and so does your brand's credibility.

We don't have time for latency!

Take the example of a busy conference center hosting high-profile live broadcasts. With dozens of video streams, microphones, control devices, and displays all operating at once, slight delays in audio and video start to create noticeable glitches. Presenters lose their flow. Viewers grow frustrated. The event's reputation takes a hit.

Latency issues in AV systems often happen because of multiple small delays stacking up across the signal path. Each stage of the system - from video capture to display output - introduces its own type of latency:

- Source-to-display latency: When video is captured, transmitted, and rendered on displays, even a small delay at each step can accumulate into visible lag.
- Compression latency: Encoding and decoding video streams, especially over limited networks, adds time while compressing and decompressing data.
- Network latency: Every switch, router, and cable segment introduces a small delay, which can become a major bottleneck when network traffic is heavy.
- Processing latency: AV hardware like encoders, decoders, and signal processors can take extra milliseconds to manage tasks such as scaling, color correction, or synchronization.
- Display latency: Some screens, particularly larger or older models, take time to scale input resolutions and render high-quality visuals.
- Audio-video sync latency: Mismatched delays between the audio and video paths create lip-sync errors that audiences immediately notice.

When AV systems rely too heavily on centralized cloud processing, these small delays become magnified. Every frame or signal has to travel back and forth across the network, creating more opportunities for bottlenecks, sync issues, and slowdowns.

Solution

Edge computing solves your latency headaches by moving processing power closer to the source. With local data handling, responses happen in real time, without the round-trip lag of a cloud server.

Action plan:

- Decode and display high-resolution video (e.g. 8K signage, live video feeds).
- Support up to four displays from a single unit.
- Run AV control applications or signage software locally.
- Perform real-time processing of video and audio (scaling, rendering, basic analytics).
- Operates without persistent internet/cloud connectivity, thanks to onboard storage and processing.
- Provide fast I/O connectivity (USB-C, Thunderbolt, 2.5 GbE) to reduce signal latency.
- Use NVMe SSD storage for low-latency media access and smooth playback.
- Leverage hardware-accelerated video decoding to optimize performance and responsiveness.
- Resume quickly from low-power states, reducing startup delays in critical-use scenarios.
- Maintain stable performance under load through efficient thermal design.

NUC 15 Pro Cyber Canyon

STEP 2

Simplify scalability

AV systems are never static. As businesses grow, open new locations, or add new services, their AV infrastructure has to keep up. Unfortunately, scaling up is easier said than done.

Many organizations find themselves locked into rigid setups that are expensive, complicated and time consuming to expand. Adding multiple screens, managing different systems across locations or upgrading performance quickly becomes a major operational headache.

Growth is good – unless your AV can't keep up

Let's go back to the example of the retail chain that decided to enhance their in-store experience with digital signage across dozens of locations. The launch was a success but when the company tried to roll out the system to new stores, the limitations of their original AV infrastructure became clear. Each upgrade required costly rewiring, new hardware, and on-site technician visits. Managing content across locations became a logistical nightmare and the delays started to impact marketing campaigns and sales.

Barriers to scaling included:

- Inflexible AV hardware that couldn't be reused or reconfigured for new environments.
- Lack of centralized or remote content management.
- Inconsistent firmware and software across locations.
- No standardized display resolution or input format support.
- Complex wiring requirements that increased install time and cost.
- Limited I/O options preventing easy connection to local peripherals or network systems.
- Dependence on on-site technical support for updates

Solution

Edge computing helps businesses avoid these headaches by decentralizing control and simplifying system expansion.

Action plan:

- Use compact, modular hardware that fits into new or existing store layouts with minimal disruption.
- Support multi-display configurations from a single device to reduce hardware sprawl.
- Manage updates and content remotely across all locations using edge processing.
- Eliminate the need for centralized servers with local playback and control capabilities.
- Reduce install time and cost with simplified I/O options and flexible mounting.
- Standardize performance across locations to ensure consistent customer experience.
- Choose the right processing power and future-proof your AV investment.
- Keep operations running smoothly during expansion with reliable, energy-efficient devices.

STEP 3

Secure AV environments

The average cost of a data breach reached an all-time high of $4.88 million in 2024.**

AV systems are connected to networks, devices and sensitive information. That makes them a target for cyber attacks. Without strong security in place, AV setups can be a weak link, exposing organizations to data breaches, unauthorized system access and reputational damage.

**Source: IBM

You locked the doors. Did you lock the screens?

A global company fitted out its boardrooms with the latest conferencing technology to enable high-level discussions across regions. However, it soon became clear that security had been an afterthought. Without encryption or secure protocols, confidential meetings were vulnerable to interception. The risk of sensitive information leaking through AV system vulnerabilities became a serious threat to the company's operations and client trust.

Security vulnerabilities include:

- Unencrypted video and audio streams exposed to interception on the network
- Open ports and default credentials on AV hardware, creating easy attack vectors
- Lack of role-based access control for devices and control systems
- No secure boot or firmware validation to prevent unauthorized tampering
- Limited logging or remote monitoring capabilities for detecting suspicious activity
- Delayed patching and firmware updates across distributed locations
- Dependence on cloud-based platforms without local failover or secure fallback

Action plan:

- Use systems with built-in hardware-level security, such as Intel vPro for advanced encryption, secure boot, and remote protection features.
- Deploy local processing to minimize data travel across insecure networks.
- Integrate NANO-BMC tools for remote monitoring, system access logging, and out-of-band management, even when the OS is down.
- Customize configurations to meet specific compliance or risk mitigation requirements with Simply NUC's custom solution capability.
- Protect sensitive AV workflows in boardrooms, control rooms, and critical facilities with tamper-resistant, high-availability designs.
- Reduce reliance on cloud-based services with on-device content control and processing.
- Enable role-based user access and endpoint authentication for added control in secure environments.

Simply NUC **extremeEDGE Server**™ range

STEP 4

Remove network constraints

As AV systems get more sophisticated, they put more strain on the network. High definition video streams, interactive displays and real-time updates can quickly overwhelm traditional networks. When bandwidth is stretched too thin, performance suffers. Live streams buffer, interactive features lag and the user experience declines.

When your network becomes the bottleneck

A large university campus launched a major initiative to live-stream lectures and virtual events. Initially the new AV systems worked great. But as usage grew across classrooms, auditoriums and event spaces the underlying network infrastructure started to show its limits. During peak hours the lecture streams would buffer, event broadcasts would freeze and video quality would drop without warning - frustrating students, staff and guests alike.

Network vulnerabilities can include:

- High-bandwidth AV content (like 4K video) clogging campus network capacity.
- Poorly optimized video compression causing excessive data transmission.
- Network switches and routers unable to prioritize AV traffic.
- Latency spikes from multi-hop data paths across campus networks.
- No local media caching, every playback request goes across the WAN.
- Increased risk of denial-of-service (DoS) attacks on central servers.
- IT teams overwhelmed with congestion and troubleshooting during critical events.

Action plan:

- Process video and audio locally at the edge to reduce bandwidth consumption by 90%.
- Use devices with multi-display output support to consolidate AV delivery without extra network load.
- Store frequently used media on NVMe SSDs for ultra-fast local access, no more repeated downloads.
- Enable hardware-accelerated video decoding to compress and render streams with minimal network dependency.
- Use NANO-BMC remote management to monitor device health without additional bandwidth overhead.
- Customize Simply NUC devices to include local failover solutions, so playback is smooth even during network interruptions.
- Utilize 2.5 GbE Ethernet support for high-speed, low-latency wired connections where wireless is unreliable.

STEP 5

Integration and compatibility

AV systems don't operate in isolation anymore. They need to integrate seamlessly with existing IT infrastructure, software platforms and a growing number of connected devices. When they don't communicate effectively, it's downtime, inefficiency and a poor end-user experience.

It works fine... until you try to connect it

A major hospital invested in a digital signage system to improve patient communication across multiple wings. Initially, the new displays helped modernize the environment. But problems soon emerged during integration. The AV equipment struggled to sync with the hospital's older IT systems. Firmware conflicts, incompatible resolution standards, and lack of centralized management tools made even basic updates difficult. What was meant to be a seamless digital transformation became a constant battle between old and new technologies.

Common compatibility issues include:

- Inconsistent AV signal standards (HDMI versions, DisplayPort incompatibilities) causing device handshake failures.
- Lack of driver or firmware support for older network infrastructure.
- Limited interoperability with enterprise control systems (like Crestron, Extron, AMX).
- Fragmented device management due to mixed vendor ecosystems.
- Display resolution mismatches requiring manual scaling and adjustments.
- Protocol compatibility issues for video-over-IP solutions (e.g., multicast support gaps).
- Cumbersome installation processes due to rigid I/O layouts and outdated connection standards.

Action plan:

- Deploy devices with extensive I/O flexibility (HDMI 2.1, DisplayPort 1.4, USB-C) to ensure compatibility across a wide range of AV gear.
- Support multiple resolutions and refresh rates natively without additional scalers or adapters.
- Integrate easily into existing control ecosystems with broad software and hardware platform support.
- Customize Simply NUC systems to meet specific AV/IT standards, including custom firmware configurations when needed.
- Utilize NANO-BMC remote technology to unify device monitoring and management across legacy and modern systems even when devices are powered off.
- Process AV signals locally to reduce reliance on network-based protocols, improving stability in mixed-environment deployments.
- Select ruggedized extremeEDGE Servers™ for environments where extreme conditions, connection density, and environmental durability matter.

STEP 6

Maintain reliability

AV systems are often deployed in environments where downtime is not an option. Whether it is a live event, a retail display, or a remote exhibition, reliability is critical. Unexpected failures, even short ones, can disrupt operations, damage reputations, and drive up maintenance costs. The challenge is even greater when systems are deployed in hard-to-reach or harsh environments.

When failure isn't an option

A remote exhibition site relied on AV systems to power digital signage, interactive exhibits, and visitor information screens. As environmental conditions changed and foot traffic increased, systems began to fail. Outages during key events damaged the visitor experience and required expensive emergency service calls. Frequent downtime not only hurt engagement but also made it harder for the venue to secure repeat bookings and partnerships.

Reliability issues can include:

- Hardware failures due to temperature extremes, dust, or vibration.
- Limited system redundancy, meaning a single point of failure could bring down displays or audio systems.
- Lack of remote monitoring tools to identify and fix issues before they caused downtime.
- Thermal throttling under high load, degrading performance during busy periods.
- Delayed or manual reboot processes, increasing recovery time after a fault.
- Software crashes or firmware inconsistencies that required on-site intervention.
- Unplanned maintenance costs from systems not designed for harsh environments.

Action plan:

- Choose devices with rugged designs and thermal management built for tough conditions.
- Use fanless or actively cooled systems depending on environment-specific requirements.
- Deploy systems with solid-state storage to avoid mechanical drive failures.
- Monitor health status proactively through NANO-BMC remote manageability.
- Enable remote rebooting and system recovery even when devices are offline with NANO-BMC.
- Implement local content caching and playback for uninterrupted service during network disruptions.
- Build redundancy into critical deployments with Simply NUC's flexible, scalable hardware options.

STEP 7

Manage AV costs

Deploying and maintaining AV systems can be expensive, especially when scaling across multiple locations. High upfront costs for equipment, complex installation requirements, ongoing maintenance, and network upgrades all add up quickly. Without careful planning, AV projects can strain budgets and reduce the return on investment.

When your AV system costs more than it earns

A small business launched an AV project to upgrade their retail spaces with dynamic displays and interactive kiosks. The tech looked great at first but hidden costs piled up fast. System crashes meant expensive service calls. Inefficient hardware meant higher energy bills. Manual updates across multiple sites stretched IT resources thin. Instead of helping the business grow, AV investment became a financial burden.

Cost issues include:

- High energy consumption from hardware design.
- Downtime requiring costly technician callouts.
- Expensive cloud service subscriptions for content management and updates.
- Can't scale systems incrementally, have to replace whole systems during upgrades.
- Poor thermal efficiency means higher cooling costs in temperature sensitive environments.
- Hardware requires custom mounting or infrastructure upgrades adding to installation costs.
- Not modular means simple repairs or upgrades are too expensive.
- Costly fees and infrastructure overhauls following a security breach or cyberattack.

Action plan:

- Deploy systems designed for 24/7 operation with low power draw.
- Use local content storage and playback to reduce cloud service costs.
- Choose modular designs that allow for incremental upgrades not full replacements.
- Use NANO-BMC for remote management to reduce on-site service costs.
- Go solid-state, fanless where possible to minimize maintenance and cooling.
- Standardize deployments across locations to simplify IT support and reduce spare parts inventory.
- Customize system builds with Simply NUC to fit your budget, environment and scaling needs.

STEP 8

Simplify user experience and training

A powerful AV system is only as good as the people who use it. If interfaces are confusing or operations are overly complex, user adoption drops. Staff frustration rises, productivity falls, and the return on investment suffers. AV solutions must be intuitive, easy to manage, and quick to learn to deliver real value.

If the system needs a manual, it's already losing

A restaurant chain deployed an advanced digital ordering and display system to improve customer flow and upsell specials. While the technology promised efficiency, it turned out to be overly complex for daily staff use. Employees struggled to manage the system without constant reference to manuals or IT support. Staff turnover made the problem worse, requiring repeated training sessions that drained time and budgets. Frustrated teams made more mistakes, and customer service times slowed instead of improving.

User experience issues:

- Overly complex interfaces requiring specialized training
- Long system startup times or delayed response to user input
- Lack of intuitive controls for managing displays, menus, or promotions
- No centralized management platform to simplify daily operations
- Limited on-device diagnostics, making troubleshooting difficult for non-technical users
- Inconsistent system behavior across different locations or devices
- Frequent software updates requiring retraining and reconfiguration

Action plan:

- Choose systems capable of real-time local processing for faster, more responsive user interfaces
- Utilize standardized hardware and software setups across locations to minimize learning curves
- Enable remote system monitoring and control via NANO-BMC to reduce on-site IT support needs
- Select models with quick boot times and low-power resume options for minimal startup delays
- Support flexible connectivity for simple peripheral integration without complex setup
- Deploy local caching and playback so content updates are seamless and automatic
- Customize UI configurations during deployment to match staff workflows and operational needs

STEP 9

Overcome environmental and physical constraints

Not every AV deployment happens in a climate-controlled conference room. Many systems are installed in tough environments – outdoor venues, manufacturing plants, transportation hubs, and other locations where dust, temperature shifts, vibration, or space constraints create serious challenges. Standard AV hardware often cannot handle these conditions, leading to failures,

AV systems don't live in perfect conditions

An outdoor event venue installed a digital signage network to improve guest experience and drive event promotions. Everything worked well during cooler months. But when summer heat, dust, and heavy foot traffic arrived, systems began to fail. Displays blacked out, media players overheated, and simple maintenance tasks became costly and time-consuming. The environment quickly exposed the limits of AV hardware not designed for real-world operating conditions.

Common environmental issues:

- Overheating due to poor thermal management in high-temperature environments.
- Dust and debris infiltration leading to system failures and degraded performance.
- Limited mounting options making hardware installations difficult in tight or exposed spaces.
- Lack of ruggedization for vibration, moisture, or humidity resistance.
- Excessive cooling or protection requirements increasing operational costs.
- Unstable system performance during seasonal temperature fluctuations.
- Physical wear and tear reducing hardware lifespan in outdoor or high-traffic locations.

Action plan:

- Select ruggedized systems specifically built for harsh and variable environments.
- Choose fanless or sealed designs where dust, vibration, or moisture are major concerns.
- Deploy small form factor devices that can be easily mounted behind displays or in constrained spaces.
- Use thermally optimized models to maintain stable performance without heavy cooling demands.
- Leverage remote monitoring through NANO-BMC to detect potential failures before they cause downtime.
- Standardize installations with hardware designed for industrial and commercial use cases.
- Customize device configurations to match environmental needs such as high temperature tolerance or rugged casing.

STEP 10

Future proof your AV investments

What's cutting edge today can be outdated in a few years as new standards, devices and user expectations emerge. Without the right foundation, businesses risk investing in systems that can't support future technologies like AI-driven

Today's solution shouldn't be tomorrow's problem

A company invested big in their conference rooms with the latest and greatest AV equipment at the time. A few years later, new collaboration tools, higher resolutions, and updated connectivity standards had the systems struggling to keep up. Compatibility issues, feature gaps and performance limitations forced the company to replace the systems long before the original investment should have reached end of life.

Vulnerabilities can include:

- Limited hardware upgrade paths, means full system replacement.
- No support for emerging AV standards like 8K, HDR or higher refresh rates.
- Non-modular design makes it hard to adapt to new technology needs.
- Not enough processing power for next gen AV applications.
- No support for evolving security protocols, older systems are exposed.
- Difficulty integrating with new collaboration platforms and control systems.
- Higher long term costs due to frequent rip and replace cycles.

Action plan:

- Deploy high performance processors and GPUs for future content and resolution standards.
- Use modular designs so you can upgrade components without replacing the whole system.
- Have multiple high bandwidth display outputs from one device.
- Choose devices with flexible connectivity options to accommodate evolving standards (HDMI 2.1, DisplayPort 1.4, Thunderbolt).
- Use Intel vPro and NANO-BMC for secure, manageable system longevity.
- Customize with Simply NUC's build to order capabilities to meet emerging technical needs.
- Standardize on rugged, scalable platforms to minimize future operational disruptions and costs.

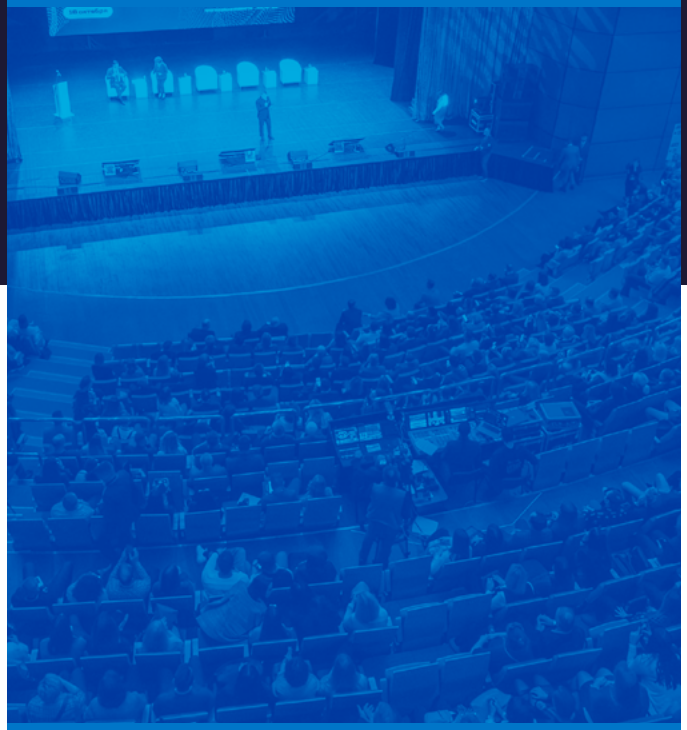
The final word

AV technology has never been more critical to business success. Whether you are enhancing customer experiences, streamlining operations, or delivering real-time communications, your AV systems need to be fast, scalable, secure, and ready for whatever the future holds.

Edge computing unlocks a smarter, more resilient way to manage AV deployments. By moving processing closer to where it is needed, organizations can reduce latency, ease network strain, strengthen security, and scale with confidence – without being held back by outdated infrastructure.

At Simply NUC, we build customized edge computing solutions designed specifically for the demands of modern AV environments. From rugged systems ready for the toughest conditions to powerful, energy-efficient platforms built for growth, our products give you the tools to deploy AV systems that perform today and adapt tomorrow.

As you plan your next AV project, think beyond the traditional approaches. With edge computing and Simply NUC, you can create faster, smarter, more reliable experiences that deliver real value – now and in the years ahead.



Your hardware toolkit

Simply NUC's AV hardware delivers security, performance, and scalability, offering compact, high-performance solutions ideal for digital signage, conferencing, and AV over IP, with reliable operation and flexible expansion.

Product	Key Strength	Use Case
Onyx	Enterprise-grade reliability, vPro support	Real-time AV processing and multi-display output
NUC 15 Pro Cyber Canyon	High CPU/GPU performance	Secure, scalable deployments with remote management
Everglades 2	Compact and modular	Resilient AV systems in constrained or mobile environments
NUC 14 Essential Mill Canyon	Cost-effective and efficient	Budget-conscious rollouts with long-term availability
Porcoolpine	Rugged, fanless performance	Harsh or thermally challenging environments
extremeEDGE Servers™	Rugged, scalable edge compute	Demanding edge deployments with remote control and AI workloads
OPS 2	Seamless integration	Plug-and-play signage and embedded AV solutions

Ready to talk about the future of AV systems? Contact our sales team today.

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