

Build Scalable Edge AI Video Surveillance Solutions for Smart Cities

Enable real-time video monitoring and analytics at the edge with local processing, integrated storage, and an open software ecosystem for partner-led solutions.

ADVANTECH

NVS-811RL



- **Compact deployment** at intersections or small sites
- **Up to 4 HDD bays** for local retention
- 24 PoE Ports (22 PoE + 2 PoE++)
- Optional Intel® Arc™ GPU or M.2 AI accelerator

NVS-821RL



- **Large sites** like transit hub or stadium
- **Up to 8 HDD bays** for extended retention
- 24 PoE ports (22 PoE + 2 PoE++)
- Same compute and expansion options

Smart City Surveillance: Business Challenge

City agencies are facing an explosion of video data from ever-growing networks of IP cameras used for traffic management and public safety. Traditional approaches that stream all videos to central data centers or the cloud for analysis have severe drawbacks:

- **High Latency:** Transmitting video feeds to centralized systems can introduce delays in detecting critical events about accidents, incidents, or security breaches. Delays in analysis can impact response time for operational teams.
- **Network Strain & Costs:** Dozens of 1080p/4K camera feeds per site consume tremendous bandwidth – often saturating networks or incurring substantial cloud egress fees.
- **Scalability & Complexity:** Scaling a city-wide system under the central model requires continuous investments in core infrastructure (servers, network upgrades). It's complex and costly for cities and systems integrators (SIs) to keep adding central capacity for each new camera deployment.
- **Reliability & Data Security:** Sole reliance on remote servers means system outages or network issues can disrupt surveillance. Constant cloud streaming can also raise data residency or privacy concerns.

City operators and solution partners need a new approach – one that brings intelligence directly to the edge. By processing video locally, near cameras, we can reduce dependency on centralized processing and improve response times and operate more efficiently, without overloading networks or sacrificing data control. Performance and configuration may vary depending on deployment scenario.

Edge AI Video Surveillance Solution Overview

This Intel + Advantech edge surveillance platform addresses those challenges by moving the heavy tasks of video decoding, analytics, and storage from the cloud to on-site edge nodes. It's a joint solution that combines Intel's Smart City edge computing platform (15th Gen Core™ architecture and an open AI software stack) with Advantech's AI NVR hardware (NVS-811RL and NVS-821RL).

How it works: Each edge node is an all-in-one appliance installed at a strategic location (e.g., an intersection, transit station, or campus). The node directly connects to up to 24 IP cameras (via built-in PoE switch) and analyzes video on the spot using integrated Intel compute and AI acceleration. Key design elements include:

- **On-device, real-time analytics:** Intel® Core™ processors with integrated GPUs perform **hardware-accelerated video decoding** (H.265/HEVC, H.264, VP9, and even next-gen AV1), then support **AI inference** workloads on video streams. This means events like collisions, intrusions, or congestion are detected in real time at the edge – rather than relying on centralized processing after cloud processing.
- **Reduced backhaul & cloud load:** Because video is processed at the edge, the system **transmits only relevant events, alerts, and slim metadata** to the central control or cloud as needed. This minimizes network usage and **optimizes** cloud and infrastructure usage.
- **Integrated local storage & retention:** Each edge node has multiple **removable HDDs** (4 or 8, depending on model) to locally buffer high-resolution footage configurable video retention based on deployment requirements under **software RAID** (0/1/5/10) for redundancy. This ensures important video evidence is stored reliably on-site, while older footage can be optionally synced to a central archive or cloud.
- **Open, flexible software stack:** The platform supports Intel's **Intel® Edge AI software ecosystem, including Metro AI Suite, DL Streamer, and OpenVINO™ toolkit**. These allow partners to optimize and run their AI models on the edge efficiently and simulate performance, enabling rapid development and tuning of analytics pipelines for city applications. Partners maintain control over their application logic and can integrate third-party video management systems (VMS), dashboards, or machine learning models on top of this open Intel/Advantech foundation.

In short, by **pushing intelligence to the edge**, the Intel + Advantech platform transforms a camera network from a passive recorder into an **active, real-time smart city tool**, while simplifying deployment for partners and improving overall efficiency.

Solution Architecture & Technical Design

Edge Node Architecture: Each Advantech NVS-811RL/ NVS-821RL edge appliance consolidates the necessary components of a complete surveillance system:

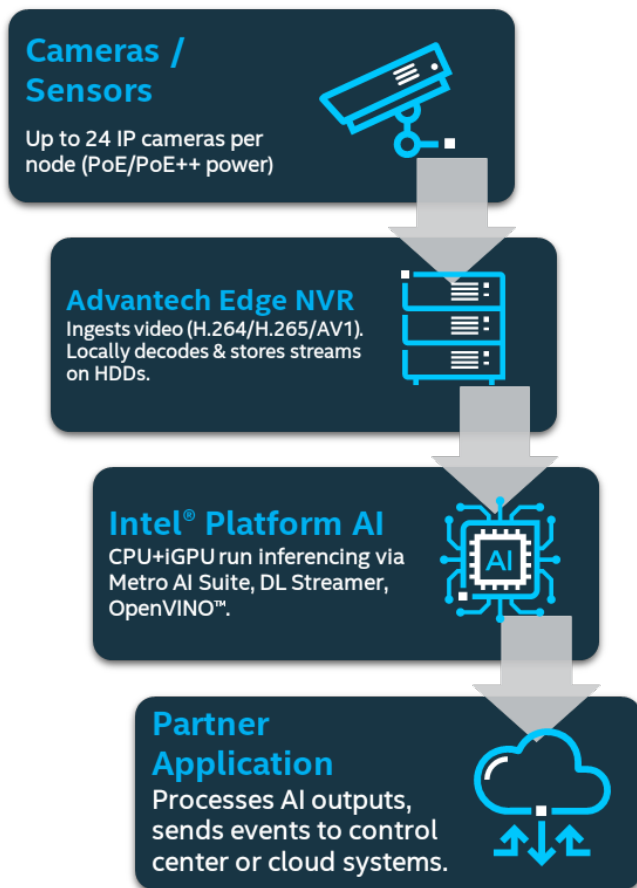
- **Videos Ingest & PoE Networking:** The appliance has **24 built-in PoE network ports** to directly connect and power IP cameras (22 PoE+ ports for standard cameras plus 2 higher-power PoE++ ports for PTZ or IR cameras). This integrated switch (with a **360W total PoE budget** across all ports) eliminates separate external switches – reducing wiring and simplifying edge deployments. The system also provides **dual 1-Gigabit uplink ports** for connecting to backhaul networks or fiber endpoints, along with a dedicated management network port (for IPMI if used).
- **High-performance Compute & AI Inference:** The NVS appliances are built on **Intel® 15th Gen Core™ i7/i5 processors (desktop class)**, offering a hybrid core architecture for robust video analytics. These CPUs come with integrated Intel® Iris® Xe graphics, which contain **dedicated media engines for multi-stream video decode/encode** (supporting H.265/HEVC, H.264, VP9, and AV1 codecs in hardware). This means each edge node is designed to support multi-camera video ingest and processing (1080p and even 4K) simultaneously without maxing out the CPU. The same integrated GPU also accelerates **neural network inference** (via Intel® XMN AI engines) to run detection and recognition models in real time. For heavier workloads, the platform supports adding an **Intel® Arc™ A370M MXM GPU** (with 128 XMN AI engines for additional deep learning throughput) or an **M.2 VPU accelerator (e.g., Hailo-8, 26 TOPS)** to scale up the local AI capacity.
- **Intelligent Storage & Resilience:** Both NVS models include **hot-swappable 3.5" HDD bays** (4 or 8 drives) for local video storage, plus a dedicated internal M.2 SSD for the OS. **Software RAID** (0/1/5/10) is supported for data protection. The system's high-efficiency power supply and **power isolation design** protect against surges or outages on PoE lines, ensuring reliable 24/7 operation. In case of network downtime, video is safely stored on the edge and can sync later, maintaining **operational resilience**.
- **Secure & Manageable at the Edge:** To address security, each appliance integrates a **Trusted Platform Module (TPM) 2.0** chip, providing hardware-based encryption key protection and secure boot measurement. Optional **IPMI 2.0** support (with a dedicated BMC NIC) allows remote out-of-band management – meaning operators can monitor system health, update firmware, or troubleshoot these edge nodes centrally, just like they would with data center equipment. This is crucial for city deployments with many distributed nodes. The platform's Linux or Windows OS can also run standard cybersecurity software and is fully compatible with network authentication and encryption protocols, ensuring the edge devices meet IT security policies.

Open Software Architecture: On the software side, the platform is built to be flexible. The **Intel® Metro AI Suite** – an open edge AI software framework – provides a foundation of libraries and sample pipelines for common tasks like video ingestion, decoding, object detection, tracking, and more. It includes the **Deep Learning Streamer** (DL Streamer) for optimized GStreamer-based video pipeline creation, and **ViPPET** (Visual Pipeline & Platform Evaluation Tool) for simulating and measuring pipeline performance under different hardware conditions. Partners can build on this to plug in their own AI models (e.g., for license plate recognition or anomaly detection) and integrate with their application logic or user interfaces. The platform's **compatibility with OpenVINO™** ensures that many pre-trained models (from the Intel Open Model Zoo or custom-trained by the partner) can be easily deployed on the edge hardware and run efficiently.

End-to-End Data Flow:

1. **IP cameras capture video** (e.g., 1080p or 4K streams) and send **compressed video (H.264/H.265)** into the Advantech edge unit's PoE ports.
2. **On the Advantech NVR:** The appliance decodes each video stream via Intel's specialized hardware engines, **buffers frames in memory**, then passes them to AI models (running on the CPU and integrated GPU) through the DL Streamer pipeline. For instance, a model might detect vehicles or faces in each frame.
3. **Local event processing:** The partner's application logic (running on the device or at a central server) interprets the AI outputs – e.g., counting vehicles, identifying an accident – and decides if an alert or action is needed.
4. **Output & Integration:** Alerts/metadata are transmitted over the network (using minimal bandwidth, e.g. MQTT messages or JSON events). These can interface with **traffic management systems, control center dashboards, or cloud DBs**. The heavy video content remains on the edge or can be accessed on-demand by authorized users via the partner's VMS application.

(The diagram below illustrates this flow, showing cameras feeding into the edge node where Intel and Advantech technologies process video, and then sending out alerts to central systems.)

**Key Features & Technical Benefits**

Integrated Edge Appliance: All-in-one hardware (compute + network + storage). The Advantech NVS-811RL and NVS-821RL edge AI NVR platforms combine a powerful Intel-based server with a built-in 24-port PoE switch and multi-drive storage. This unified design **reduces deployment points** – no separate server, switch, or NVR needed – simplifying on-site installation and maintenance. Both models have industry-standard rack-mount form factors (short-depth) for easy integration into city cabinet enclosures or control rooms.

Scalable On-Device Performance: The edge nodes are **purpose-built for high camera density**. They support up to **24-channel video input** (based on system configuration) concurrently without dropping frames, thanks to Intel's multi-stream hardware video decode capabilities. For heavier AI tasks or higher resolutions, optional acceleration (Arc GPU or M.2 VPU) can be added. This means the system can grow with needs: start CPU-only for moderate analytics, add a GPU later for more channels or advanced algorithms. No forklift upgrades required – just plug in an accelerator if needed.

Real-Time Analytics & Low Latency: By performing both **video decoding and AI inference on-site**, the platform enables **instant event recognition**. For example, the moment a wrong-way vehicle enters an intersection, the edge node's AI can flag it and notify city operators in real time, instead of waiting for data to travel to a data center. This **low latency** workflow helps cities respond fast to emergencies, adjust traffic lights dynamically, or make timely public safety interventions.

Advanced Media & AI Processing: Under the hood, the Intel platform provides **dedicated AI and media engines**. The integrated GPU's media engines handle modern codecs (so even **4K 60fps video** can be processed if needed), and the integrated **XXM AI engines** accelerate neural networks (object detection, license plate recognition, etc.) as if a small inferencing accelerator is built in. The **Metro AI Suite** orchestrates these pipelines efficiently across CPU and GPU, so partners get maximum throughput per node without needing deep expertise in parallel programming.

Storage & Data Management: With **multi-terabyte local storage** (up to 8 HDDs on the 821RL model), each node can be configured for **extended video retention and edge recording**. In practice, that means at a busy intersection, local storage enables configurable video retention based on deployment requirements under RAID-5 or RAID-10, safeguarding data against drive failure. If a network outage occurs, **operation continues unaffected** – footage is buffered and later synced if required. This reliability is critical for evidentiary video (e.g., for investigations after an incident) and ensures no coverage gaps due to connectivity issues.

Security & Manageability: The solution incorporates **modern cybersecurity features** and remote management. **TPM 2.0** ensures that each edge node can support features such as disk encryption and secure boot (including hardware-based security features such as TPM 2.0 for platform integrity). For large deployments, **optional IPMI remote management** offers lights-out control – a city's IT team or the SI can reboot a device,

check system status, or even reload firmware over the network. This is immensely valuable for managing dozens or hundreds of nodes across a city without expensive truck rolls. The platform also supports standard network management tools and can integrate with management systems via secure SNMP or Redfish APIs if needed.

Open Software for Partners: Unlike closed proprietary NVRs, this Intel + Advantech platform runs standard operating systems (Linux or Windows) and **open SDKs**, meaning SIs and ISVs can install their own analytics or VMS software on it or use Intel's provided open-source pipelines as a starting point. Tools

like **OpenVINO™** allow partners to run a wide range of neural network models optimized for Intel hardware. **Deep Learning Streamer (Intel DL Streamer)**, built on GStreamer, lets partners chain together custom video and AI “elements” to construct unique analytics pipelines – for example, decode → infer → tracking → encode, all on the device. **VIPPET** (Visual Pipeline & Platform Evaluation Tool) helps simulate how a pipeline will perform under various conditions or hardware configs, so integrators can plan deployments more confidently. All these tools are free and community-backed, **accelerating partner development cycles** significantly.

Advantech Reference Platform Options

The joint solution is offered via two Advantech appliance models to suit different site requirements. Both models share the same compute platform and features; they mainly differ in storage capacity and form factor.

Advantech AI NVR Model	NVS-811RL (Compact 1U)	NVS-821RL (Extended 2U)
Ideal for	Typical intersections, small facilities – moderate retention needs. 4 removable HDD bays for local video recording.	Larger junctions, transit hubs, central nodes – longer retention or heavy camera density. 8 removable HDD bays for maximum on-site storage.
PoE Camera Ports	24 (22 × PoE+ & 2 × PoE++), 360 W total power budget – connect up to 24 direct IP cameras per device.	24 (22 × PoE+ & 2 × PoE++) – same 360 W budget. Supports identical camera counts with double the drive capacity.
Compute & AI Acceleration	Intel 15th Gen Core™ i7/i5 CPU (Q670 chipset) with integrated Iris® Xe GPU (supports hardware decode for HEVC, AV1, etc.). Up to 64 GB DDR5 memory. Optional 1 × MXM (Arc A370M) or 1 × M.2 AI module for extra inferencing if needed.	Same compute as NVS-811RL – identical CPU, iGPU, memory, and accelerator options. Larger chassis supports 8 drives (with a higher capacity PSU), but compute performance is the same.
Security & Manageability	TPM 2.0 on board for platform security. Optional IPMI module for out-of-band management.	TPM 2.0 on board. Optional IPMI support. (Both models integrate with secure IT management workflows identically.)
Notable	Short-depth 1U rackmount chassis – fits compact/network cabinets. Lower weight.	Deeper 2U rackmount. Slightly higher power supply capacity to handle more drives.

Common Interfaces: Both models include 2 × 1 GbE uplink ports, 4 × USB 3.0, dual HDMI outputs for local display (if needed), 4 × digital I/O (e.g., alarm relay integration), and audio I/O (line-in/line-out).

Smart City Use-Case Highlight

This edge platform is flexible and can underpin many city surveillance scenarios. Three example applications include:

- **Smart Traffic Intersections:** At a busy city intersection, an NVS-811RL connects to multiple traffic cameras (covering each approach). **Local AI models** (vehicle detectors, red-light violation detectors) process video in real time to catch incidents like accidents or congestion onset. The node can then **immediately trigger an alert** to the city's traffic control center or even directly adjust traffic signal timing via an IoT interface. By doing this on-site, the system **avoids delays** – potentially preventing secondary accidents and reducing gridlock. All the while, full-resolution video is stored on the node and only key metadata (vehicle counts, event flags) are sent over the network to central servers, preserving bandwidth.

- **Public Safety Surveillance (City Center or Campus):** Deployed around a downtown area, park, or large campus, an NVS-821RL handles a network of security cameras. The **onboard analytics** might include person detection, crowd density analysis, or loitering detection. If the edge node's AI **spots a safety threat** (e.g., an unauthorized entry at a restricted area or an unattended bag), it generates an instant alert with a snapshot to city law enforcement's dashboard. Because footage is analyzed and stored locally with encryption (enabled by TPM), **sensitive video data stays on-site**, addressing privacy concerns. The platform's RAID storage and redundant power design also mean it can **serve as a temporary recorder** even if connectivity to police HQ is lost, and sync later when restored.
- **Transportation Hubs (Stations, Airports):** Large transit stations often have hundreds of cameras. Several Intel and Advantech edge nodes can be distributed throughout an airport terminal or train station concourse, each covering a zone of ~20-24

cameras. They run **analytics like identity management or people counting** to assist security and operations. For example, if a security camera sees a person of interest, the local node's AI can match the face and send an alert to security – instead of relying on a human to spot them manually. Meanwhile, the node is recording all feeds locally. Because the platform is open, the transit authority's existing **Video Management Software (VMS)** can run on it, merging seamlessly with the AI pipelines: they get the benefits of edge AI without completely replacing their existing systems.

(The timeline below summarizes how edge analytics benefits these scenarios, from immediate incident detection to reduced network usage.)



Conclusion & Next Steps

The Intel + Advantech Smart City Edge Video Surveillance platform is a ready-to-deploy **reference solution** that



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addresses the technical challenges of modern city surveillance by combining **Intel's compute and AI strengths with Advantech's field-proven hardware design**. It enables partners – system integrators, software vendors, and city IT teams – to roll out advanced video analytics at the edge with confidence, using an open and scalable platform rather than a black-box NVR.

For partners and SIs, this means fast project execution (leveraging Intel's open software tools), easy integration of your own analytics or VMS, and a clear path to scale solutions across more sites without re-architecting the core.

For city end-users, the value is in **enabling improved real-time responsiveness, lower TCO, and improved data governance** – critical incidents are caught and acted upon fast, network and cloud costs are reduced, and sensitive data can be kept on-site by design.

Contact: For further information or to arrange a demo/pilot, **please reach out to your Intel® or Advantech representative to explore deployment and partner integration opportunities**. Our teams can provide additional technical information and support for solution development to help you adopt and customize this edge video platform for your Smart City projects.

Learn More

Learn more about how Advantech and Intel are enabling edge AI video surveillance solutions for smart cities:

Video & AI Cities Community **Intel® Metro AI Suite**

For collaboration opportunities, solution deployment, or technical integration support, please contact:

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