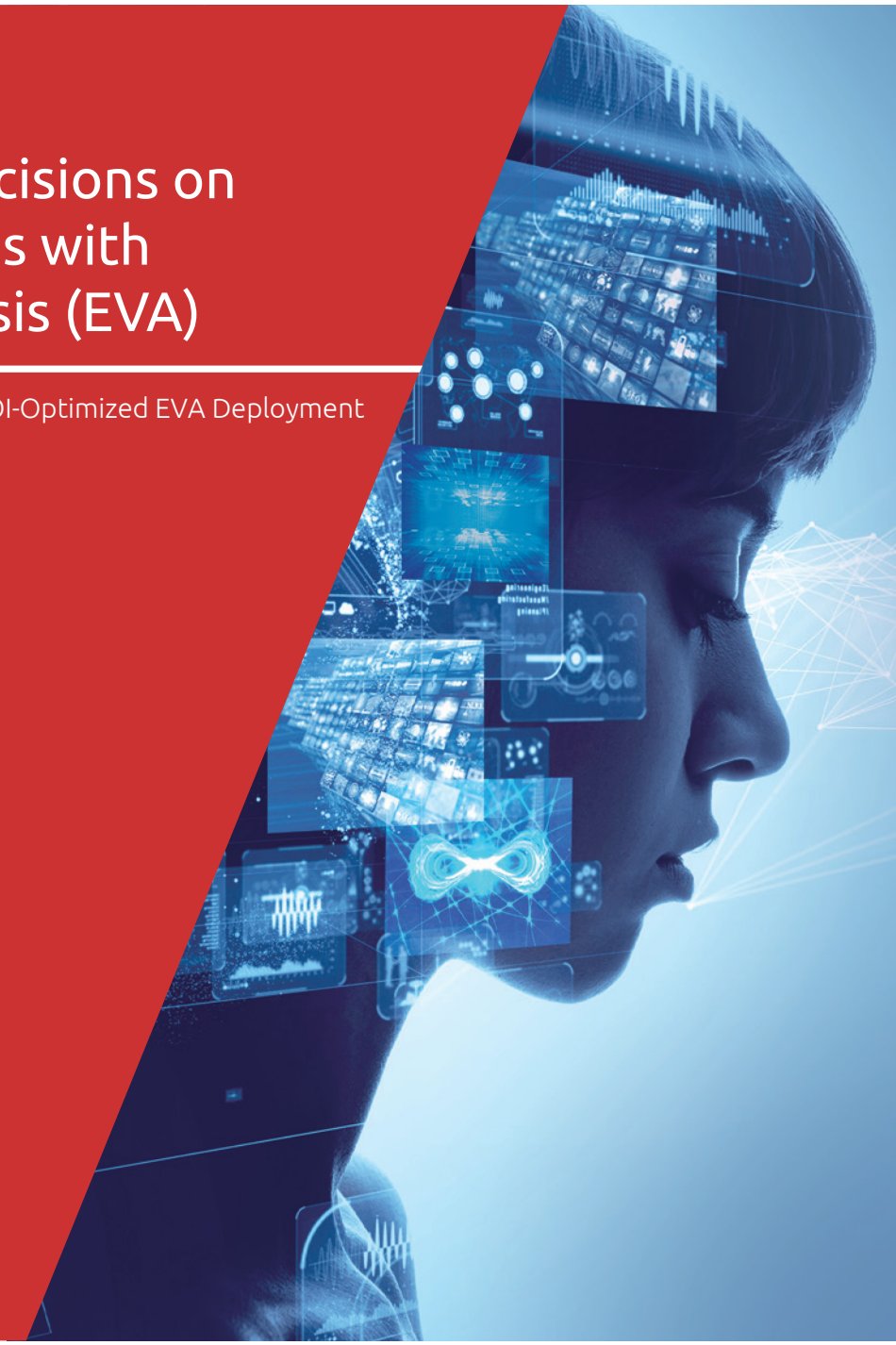
ADLINK
Leading EDGE COMPUTING

Solution Blueprint

Making Better Decisions on Embedded Devices with Edge Video Analysis (EVA)

ADLINK GPU Solutions Accelerate ROI-Optimized EVA Deployment



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Executive Summary

The decision-making capabilities of embedded devices have vastly improved through the integration of artificial intelligence (AI) technologies into video analysis solutions. Earlier generations of video analysis applications were rule-based and static, typically limiting decision-making algorithms to rules and parameters previously defined by device developers and users, as shown in Figure 1. Today, AI-based video analysis is enabling a wider universe of decision possibilities by allowing devices to optimize algorithms according to the situation (i.e., sensor data), instead of being constrained by rigid coding.[1]

Given that AI-based algorithms are particularly data and compute hungry, they are usually hosted in the cloud. But this approach, which sends vast amounts of data to the cloud, can lead to unacceptable latency (speed of response), high network bandwidth usage, downtime due to intermittent network connections, and data security compromises. Addressing these issues, on-location edge video analysis (EVA) is emerging as a better alternative for real-time and safety-critical embedded applications. Today, EVA-based solutions are available across a wide variety of industries, including manufacturing, healthcare, transportation, and aerospace.

For those selecting EVA solutions, this paper discusses key design considerations, such as AI workload optimization, reliable system operation, future-proofed system design, and environmental constraints. ADLINK products with pre-integrated NVIDIA graphics processing units (GPUs) and Intel CPUs can greatly simplify the product design process for system developers, OEMs, and systems integrators.

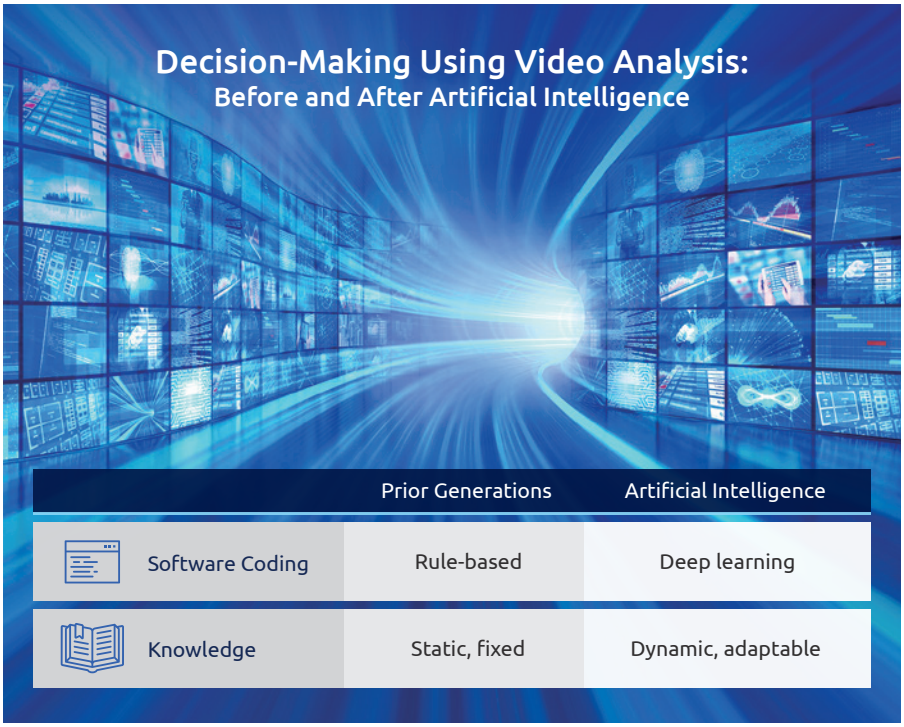

Figure 1. Video analysis using artificial intelligence enables dynamic and adaptable decision-making.

Why Video Analytics at the Edge

Many industries are employing edge video analytics (EVA) to increase productivity, security, and safety in a wide variety of use cases, such as:

Increase Productivity

EVA can help boost productivity by providing the 'eyes' needed to automate various tasks. In manufacturing, EVA improves quality assurance by performing automated optical inspection (AOI) to detect product defects. For oil and gas companies implementing predictive maintenance programs to reduce unplanned downtime, EVA helps determine when remote equipment, like drilling rigs, is likely to fail. Logistics teams transport materials in warehouses using autonomous guided vehicles (AGVs) that rely on EVA to identify optimal travel paths and detect obstructions.

Improve Security

Security can be enhanced using EVA-based facial recognition to accurately identify specific individuals. Examples include ticket validation in the transportation industry (e.g., bus, subway, and plane), gate access control at smart buildings (e.g., factories, businesses), and surveillance of smart cites.

Enhance Safety

EVA devices can detect deviations from expected safe patterns and notify the appropriate people to take corrective action. For example, an EVA device can notify workers getting too close to an operating oil rig to step back, or it can alert train conductors and airport controllers about dangerous obstacles on train tracks and runways that are too far away for them to see. Inspections robots using EVA to navigate around buildings can also look for unsafe conditions.

Advantages of EVA

Some use cases require high levels of computing power in order to deliver timely and accurate results. For example, a gate access control installation at a factory entrance must quickly and precisely identify those permitted to enter the facility in order to avoid long queues and unauthorized admittance.

To satisfy stringent speed and accuracy requirements, solution developers are implementing EVA solutions on-site, where the data is generated, instead of off-site in a data center or the cloud. EVA eliminates the need to upload potentially massive amounts of video data, from many high-definition (4K or higher resolutions) cameras, to the cloud. As a result, EVA offers significant performance, cost, reliability, and security advantages compared to video analytics running in the cloud, as described in Table 1.

Advantages	Edge Video Analysis	Cloud Video Analysis
Faster response	✓	Sending video data to the cloud adds significant delay.
Lower network cost	✓	Sending video data to the cloud consumes costly network bandwidth.
Higher reliability	✓	Depending on a persistent network connectivity to sustain operation is risky.
Better data security	✓	Transmitting video data off premises increases the risk of data compromise by hackers.

Table 1. Advantages of edge video analysis (EVA) compared to cloud video analysis

Key Considerations When Selecting an EVA Solution

The return on investment (ROI) of an EVA solution can be significantly impacted by software and hardware factors, such as:

AI workloads

An AI-optimized EVA platform requires a powerful GPU and large amounts of memory; however, it is important to profile AI workloads to ensure the platform is not over-provisioned and cost-effectively satisfies the application's speed and accuracy requirements.

Use profiling tools to model computing platform performance based on the elements of AI algorithms, such as the types of neural networks (e.g., AlexNet, MobileNet, ResNet) and batch size. These tools can help determine the best hardware accelerators for the neural networks used by the EVA application.

Reliable system design

EVA solutions using commercial graphics solutions, such as those developed for gaming applications, will often have a failure-prone fan mounted on the GPU. Choose instead a reliable, fanless EVA solution that employs an embedded GPU, supporting temperature extremes for use in demanding edge environments.

Future-proof system design

Maximize your ROI by choosing hardware that can extend the breadth and lifetime of an EVA-based product family. For instance, some hardware platforms are scalable, designed to support GPU upgrades as well as GPUs in different form factors. Likewise, some hardware platforms are expandable, simplifying system integration and making it easier to later add application-specific functions. Select hardware with extended lifecycle support to accommodate long development cycles and long product lifetimes of edge applications.

Environmental constraints

EVA solutions are deployed in a wide variety of environments, sometimes with stringent constraints, like size, weight, and power (SWaP), battery-powered, and vibration. Understand such constraints during EVA selection to avoid selecting an EVA solution that is a poor fit for its environment and incurs unexpected installation and deployment costs.

ADLINK Solution Overview

AI-based video analysis programs have diverse requirements that can be satisfied by computing platforms with different types of computing cores, a design approach called heterogeneous computing. Figure 2 shows video application workloads that are best handled by CPUs and GPUs; a platform with both types of processors is equipped to maximize inferencing speed.

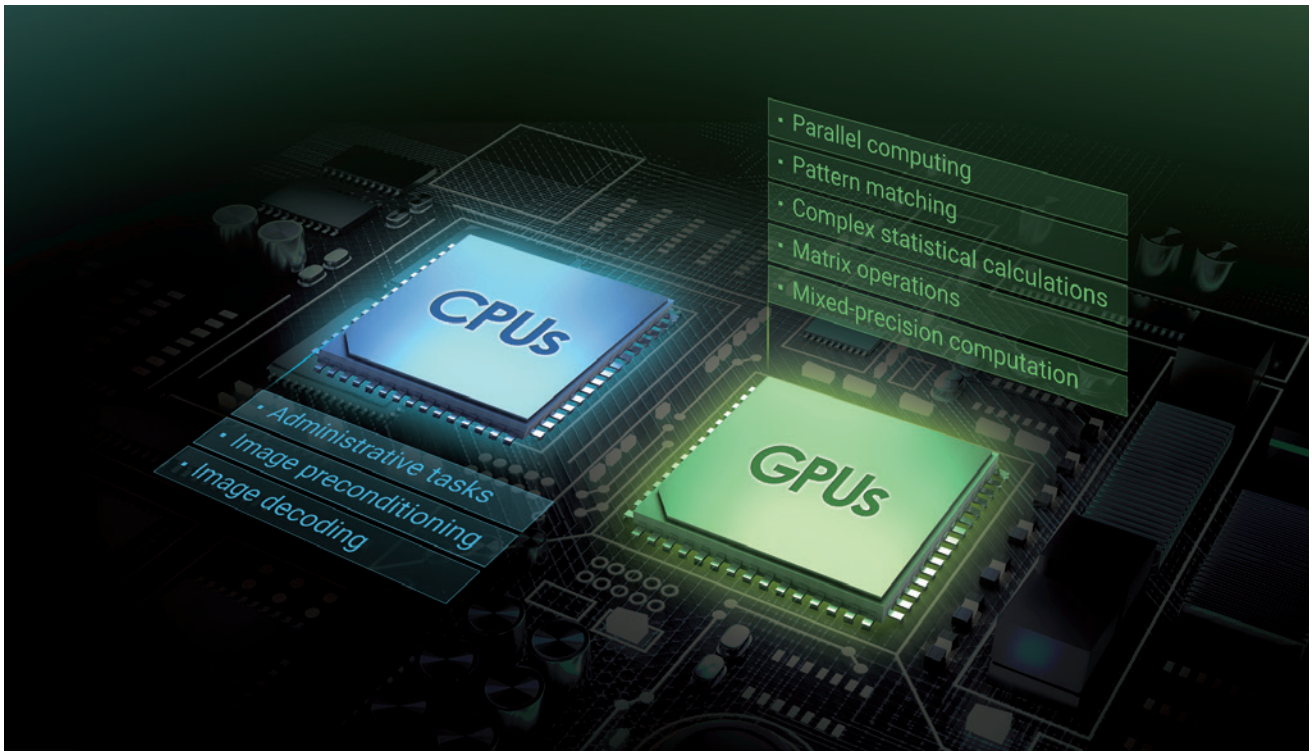

Figure 2. Common workloads for CPUs and GPUs in video analysis applications

Optimized for AI-based EVA solutions, ADLINK's extensive heterogeneous portfolio includes a mix of GPUs and CPUs that accelerate AI workloads running on board-, system-, and server-level products.

ADLINK offers a deep learning profiling tool to help developers determine the right hardware platform to satisfy their EVA application needs in a cost- and power-efficient manner. The ADLINK-developed profiling tool models EVA performance for popular neural networks based on their batch size, and generates statistics, including inferences per second, performance per watt, and performance per dollar.

Additionally, the tool helps developers determine whether they are using the best accelerators for the neural networks used by their application and suggests which accelerator may offer the best performance.

ADLINK can further optimize system performance by identifying hardware and software bottlenecks due to insufficient platform resources (e.g., memory, I/O, computing cores, and cache), inefficient scheduling of software threads, or contention between various running processes, which, when remedied, can increase throughput and responsiveness.

ADLINK's portfolio of GPU-based solutions offer different performance levels, power efficiency, and form factors for AI applications. For EVA solutions deployed in harsh environments, ADLINK fanless embedded computers combined with Mobile PCI Express Module (MXM) GPU modules are designed to operate reliably despite poor ventilation, limited space, temperature extremes, and dust-prone and corrosive conditions. For applications where performance is at a premium, expandable embedded computers offer scalable GPU acceleration with PCI Express graphics (PEG) cards to boost large-scale, compute-intensive video analysis.

The portfolio features extended lifecycle support, which greatly benefits mission-critical devices, like medical systems, that must undergo time-consuming verification and testing processes. Extended product lifetime reduces the development time, effort, and costs caused by the end-of-life (EOL) of critical parts, like GPUs.

Solution Benefits

Developers can better leverage AI to achieve their business objectives by employing ADLINK solutions that enable accelerated and ROI-optimized deployment of EVA applications (Figure 3). At the same time, developers can take advantage of fast AI technology advances incorporated in the ADLINK product family.

At a time when AI experience and expertise is scarce, ADLINK helps developers avoid a costly, cumbersome, and trial-based development process. ADLINK products are designed and proven to satisfy SWaP constraints and operate in harsh operating environments to keep EVA solutions functional and stable. These products are also flexible, allowing customization on both hardware and firmware levels. ADLINK long life support helps minimize EVA solution churn and repeated functional validation and certification of existing products.

Quickly Add Edge Video Analysis (EVA) to Your Portfolio

With help from ADLINK's large portfolio of computing products, system developers, OEMs, and systems integrators can quickly offer EVA products to meet growing demand in the embedded market. ADLINK, closely aligned with NVIDIA and Intel, is delivering high-performance, long-life, AI-based graphics solutions to many market segments.

Take advantage of ADLINK's edge computing solutions and deep learning profiling to optimize the performance of AI-enabled EVA devices.

Figure 3. EVA-based solutions are available across a wide variety of industries.

1. Jun Hong Park et. al., "Dependable Fire Detection System with Multifunctional Artificial Intelligence Framework," April 30, 2019, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6540297.

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