# Expanding FantoVision Family: Breaking the Jetson I/O Wall

After the groundbreaking success of the FantoVision20 and FantoVision40, combining **NVIDIA Jetson Orin NX** with **FPGA AI accelerator** technology, Gidel now introduces three dedicated models designed for applications requiring **CoaXPress 12**, **10GigE Vision**, or **Camera Link**. These systems do not replace existing capabilities. Instead, they offer optimized, interface-specific edge AI vision systems for developers who need maximum bandwidth, determinism, and sustained AI performance at the edge.

The promise of Edge AI Vision is the ability to perform real-time inference directly at the point of image capture. The NVIDIA Jetson Orin NX, delivering up to **157 TOPS**, provides server-level AI in a compact form factor. Yet as modern imaging systems demand higher aggregate I/O bandwidth through increased resolution, higher frame rates, and simultaneous multi-camera acquisition, developers encounter a persistent bottleneck: "the Jetson I/O Wall".

In practice, standard embedded computers struggle to handle raw, high-bandwidth video streams without overwhelming the CPU. The FantoVision family was designed specifically to solve this problem.

## Understanding the Jetson I/O Wall

While the NVIDIA Jetson Orin NX delivers exceptional edge AI vision performance, its ability to ingest data is constrained by standard interfaces. As modern industrial cameras push far beyond 10 Gb/s and transmit millions of packets per second, the Jetson’s ARM CPU must process every interrupt, decode every packet, and rebuild every frame in software.

As a result, this creates a hard limit on how much data the Jetson can accept before the CPU becomes saturated. Once this limit, the "I/O Wall", is reached, camera streams begin to drop frames, latency increases, and AI performance collapses due to CPU overload and thermal pressure.

**Gidel’s architecture eliminates this bottleneck** by moving packet handling, protocol termination, and raw data movement into a deterministic FPGA AI accelerator redefining what is possible in modern edge vision.

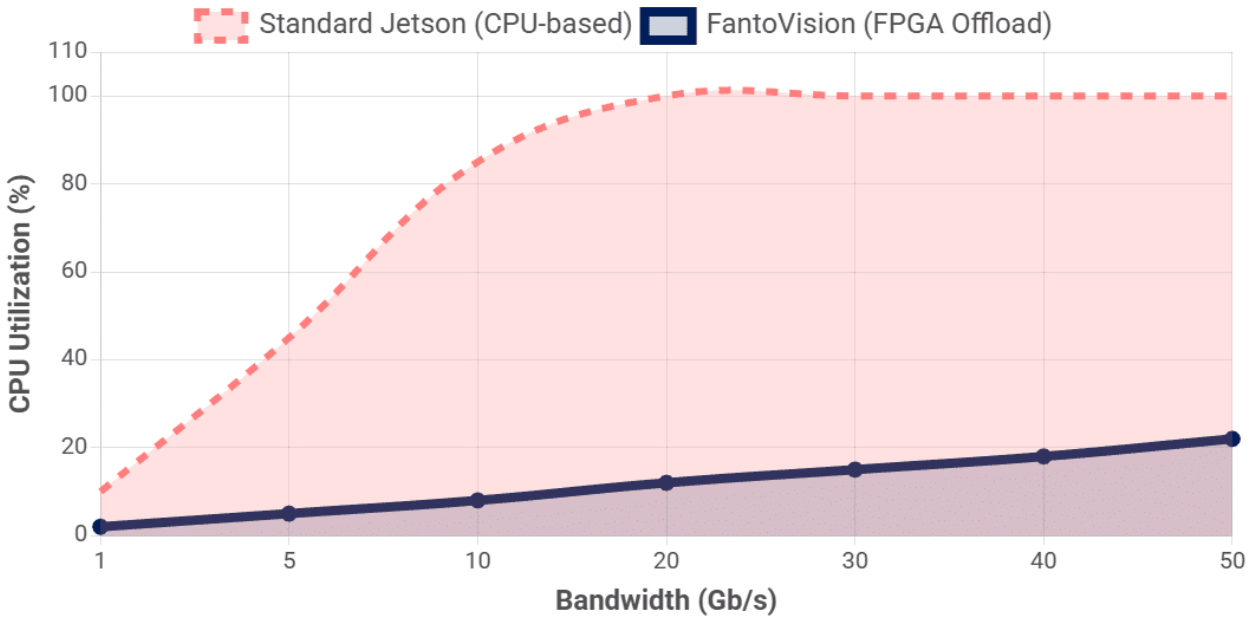


Figure 1: **CPU Load Wall -** While standard systems saturate the CPU at high bandwidths, FantoVision's FPGA offload keeps CPU load below 25%, breaking the I/O Wall.

## The Challenge: When Jetson Chokes on Pixels

High-end Machine Vision Solutions, particularly those deploying edge vision AI, require not only compute power but also deterministic, high-bandwidth image acquisition.
A typical embedded system forces the CPU to act as the frame grabber. With streams reaching 10 Gb/s, 20 Gb/s, or even 50 Gb/s, the ARM CPU spends most of its time handling interrupts, stripping headers, and copying data. This overhead is the "CPU Tax".

## The CPU Tax of High-Bandwidth Acquisition

In software-based acquisition, every incoming packet triggers a CPU action. When millions of packets per second arrive, CPU utilization can easily reach 100% per core. This leaves little headroom for inference, application logic, PLC messaging, or compression tasks. Multi-camera setups make this problem even worse and often cause dropped frames or instability.

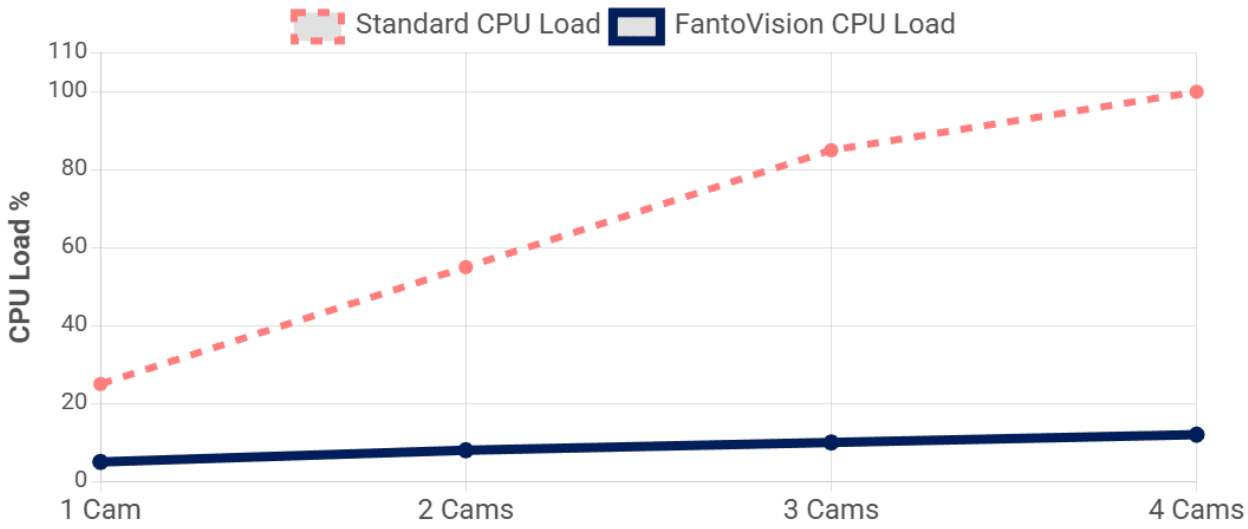


Figure 2: **Multi Camera Scale -** Adding cameras to a standard system causes CPU load to skyrocket. FantoVision maintains a flat, efficient profile regardless of camera count.

## Latency and Synchronization Problems

Industrial imaging requires deterministic latency. Standard operating systems introduce jitter in the millisecond range. This jitter disrupts multi-camera synchronization, breaks high-speed inspection pipelines, and prevents precise timing between image capture, PLCs, and robotic motion.

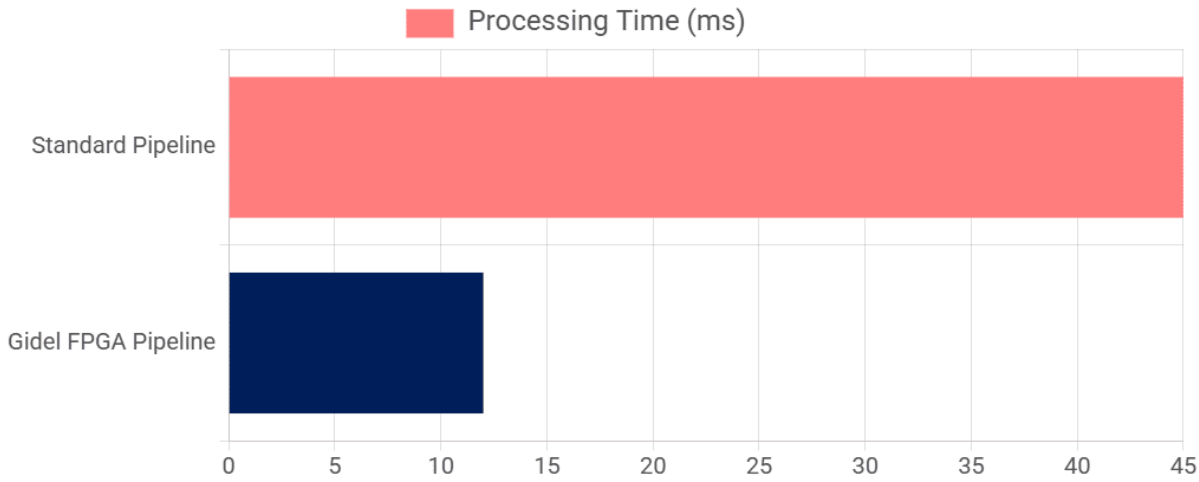


Figure 3: **Pipeline Latency -** Traditional serial processing on a CPU creates bottlenecks. The FPGA pipeline processes data in parallel, drastically reducing latency.

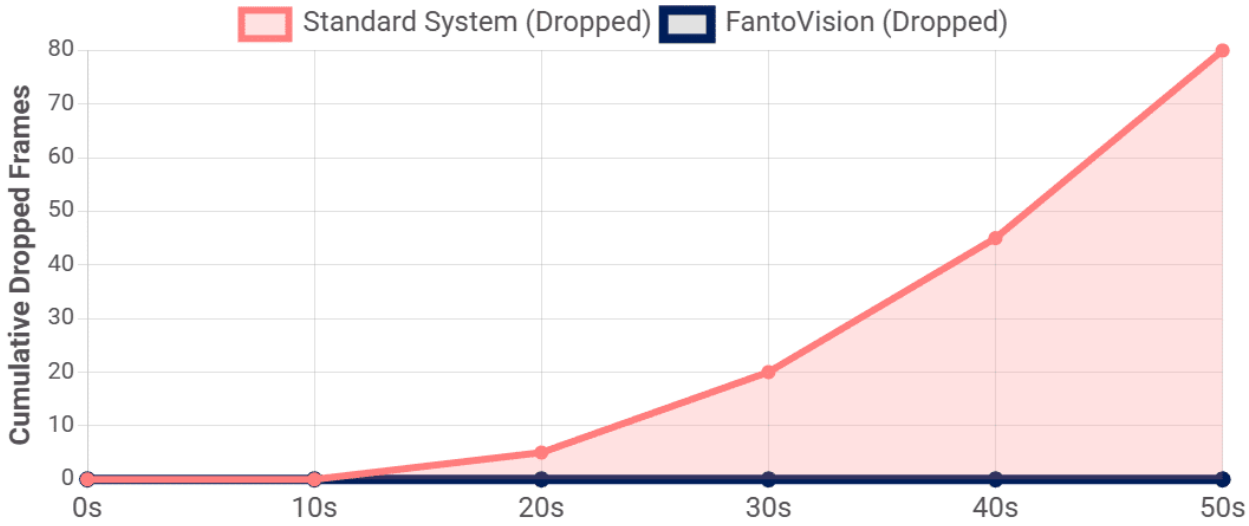


Figure 4: **Frame Stability -** Under sustained high load, standard systems begin dropping frames as buffers overflow. The FantoVision maintains zero dropped frames stability over time.

Crucially, when the CPU is overwhelmed by jitter and interrupts, frames start to drop. **This data loss is unacceptable in medical, defense, or high-speed inspection applications.**

### Thermal Implications

Consequently, running the CPU at high load drastically increases thermal output. When acquisition overhead consumes the thermal budget, the Jetson cannot sustain its full 157 TOPS performance. Thermal throttling becomes inevitable, so the system never reaches its intended AI capacity in real production conditions.

## The Solution: Heterogeneous Computing in an Edge AI Vision System

Each FantoVision model integrates a Jetson Orin NX with an Intel Arria 10 FPGA, forming a heterogeneous edge AI vision system that splits responsibilities between GPU, CPU, and FPGA.

The FPGA is not a passive peripheral but a Smart I/O Engine.

### Optimized Acquisition Path for Edge AI Vision and Minimal CPU Load

The FPGA terminates the camera protocol, manages timing, validates data, and performs DMA transfers directly into Jetson memory that is immediately accessible by the GPU. The CPU is only notified when a complete frame is ready.

This eliminates software packet handling and reduces CPU acquisition load to **below 25%, even under sustained high throughput**. The result is a cooler CPU, more stable system behavior, and significantly more thermal headroom for edge AI vision inference.

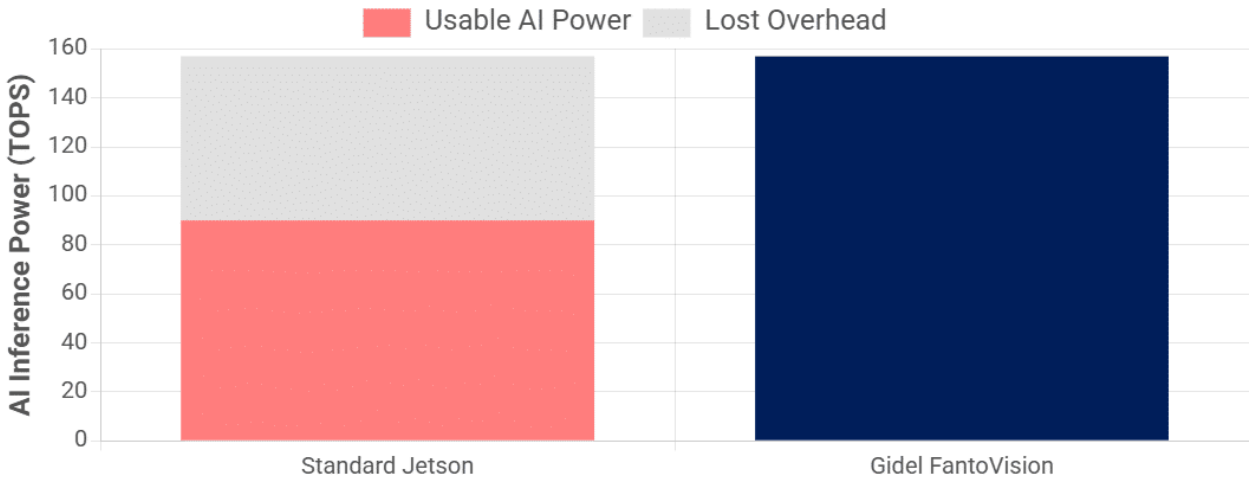


Figure 5: **AI Headroom -** High CPU overhead in standard systems effectively reduces available AI performance. FantoVision unlocks the full 157 TOPS for your algorithms.

**FPGA-Based Pre-Processing & Streaming**

The FPGA can offload ISP and other pixel-intensive operations, reducing Jetson CPU load and ensuring deterministic real-time performance. Capabilities include:

**Image Processing: Debayering**, Non-Uniformity Correction (**NUC**), Bad Pixel Replacement (**BPR**), White Balance, Gamma Correction, **HDR** correction and dynamic luminance balancing.

**RTSP Output:** The system supports Real-Time Streaming Protocol (**RTSP**) output, enabling low-latency video streaming to remote clients or control centers, ideal for drones and security applications.

**Data Optimization:** ROI cropping, scaling, and compression including **JPEG**, **Lossless**, and **Quality+**.

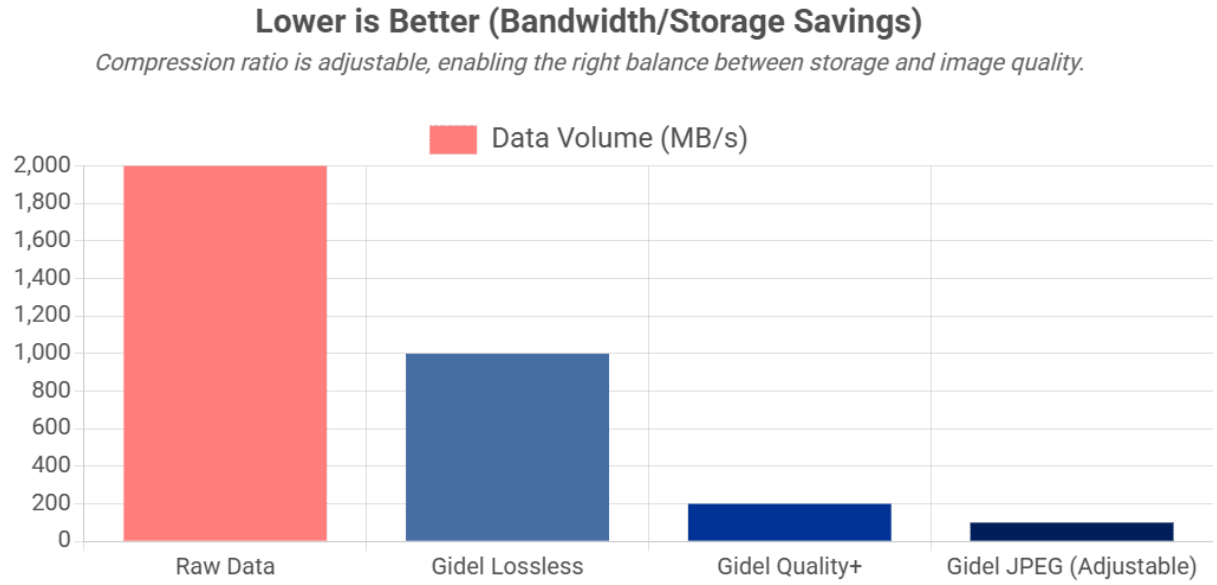


Figure 6: **Gidel's Compression Savings -** Gidel's real-time compression technologies significantly reduce bandwidth and storage requirements, with adjustable JPEG ratios to balance quality and size.

### The Gidel Architecture Advantage

| Standard Jetson System vs Gidel FantoVision Edge AI Vision System | | |
|---|---|---|
| **Feature** | **Standard Jetson System** | **Gidel FantoVision System** |
| Supported Interfaces | USB, MIPI, Standard GigE | CoaXPress 2.1, 10GigE Vision, Camera Link (Deca) |
| Processing Resources | Jetson only | Jetson (AI) + FPGA (ISP and pre-processing) |
| Acquisition CPU Load | High, often > 60% per core | Low, typically < 25% |
| Streaming | CPU-heavy encoding | Optimized RTSP Out |
| Latency Consistency | OS dependent, variable jitter | Hardware-driven, deterministic timing |
| High-Bandwidth Ingestion | Limited by standard interfaces and CPU load | Optimized for high-speed cameras |

## Three New Dedicated Edge AI Vision Systems

These models bring interface-specific optimization to developers who require peak performance, reliability, and determinism in their Machine Vision Solutions.

### The NVIDIA CXP System: FantoVision40-CXP12

**Target Applications:** High-speed inspection, defense, volumetric capture, drones, sports analytics, medical imaging...

- Performance: **Quad CXP-12 links**, delivering up to 50 Gb/s bandwidth.
- FPGA Integration: Built-in CoaXPress 2.1 frame grabber tightly integrated with the FPGA.
- Power: Supports PoCXP (Power over CoaXPress) with up to 13W per cable, simplifying cabling and power in weight-sensitive platforms...
- Connectivity: Micro-BNC connectors for compact, secure locking in high-vibration environments.
- Ideal For: ultra-fast area scan sensors and line-scan cameras.

### The NVIDIA 10GigE Vision System: FantoVision20-GigE

**Target Applications:** Intelligent Traffic Systems (ITS), stadium security, Military, surveillance, UAV imaging, and Aerial Inspection...

- Performance: **Dual independent 10GigE Vision ports** (SFP+ or RJ45), supporting up to 20 Gb/s total bandwidth.
- Offload Engine: Full FPGA-based UDP and GVSP offload engine for parsing, error checking, and resend handling.
- Stability: Eliminates "interrupt storms" that typically overload embedded CPUs with high-bandwidth Ethernet.
- Versatility: **Supports multi-camera aggregation** or single high-bandwidth dual-link cameras.

## The NVIDIA Camera Link System: FantoVision20-CL

**Target Applications:** Legacy modernization, line scan inspection, medical imaging, military & defense...

- Compatibility: Supports Base, Medium, Full, and **80-bit Deca** Camera Link configurations.
- **Dual Base**: Unique Dual Base mode allows for the connection of two independent Camera Link Base cameras.
- Determinism: Provides the rock-solid triggering accuracy required for long-established production lines.
- Retrofit: Ideal for replacing large PC-based vision systems with compact, AI-native edge computing.

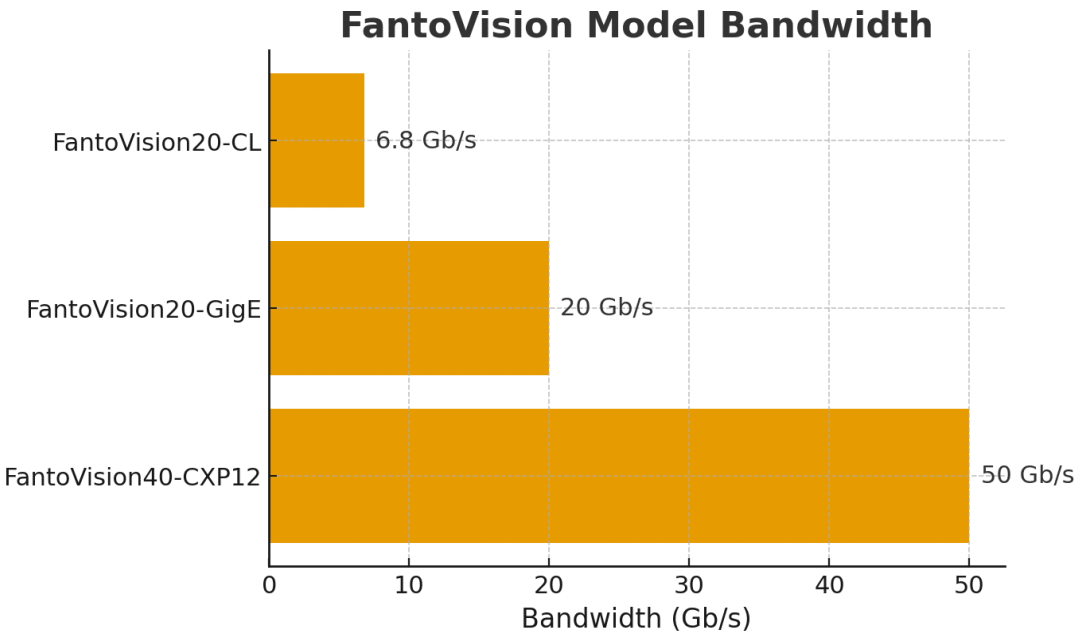


Figure 7: **FantoVision models bandwidth comparison**

**FantoVision Model Specifications Overview**

| Model | FantoVision40-CXP12 | FantoVision20-GigE | FantoVision20-CL |
|---|---|---|---|
| Primary Interface | CoaXPress 2.1 (4x CXP-12) | 10GigE Vision (2x Ports) | Camera Link |
| Max Bandwidth | 50 Gb/s | 20 Gb/s | 6.8 Gb/s (Deca) |
| Configuration | Quad-link CXP-12 | Dual port, SFP+ or RJ45 | Deca, Full, Medium, Dual Base |
| Power Over Cable | Yes, PoCXP | No | No |
| Connector Type | Micro-BNC | SFP+ or RJ45 | SDR or MDR |
| IP Rating | IP51 | IP53 | IP53 |

### Compact, Rugged, and Built for the Extremes

The FantoVision family is not just about electronic performance; it is engineered for physical resilience in the harshest environments.

### Unmatched SWaP-C Optimization

**Dimensions:** 134 x 90 x 60 mm
**Weight:** 750 g

By packing workstation-class I/O into a palm-sized chassis, Gidel enables high-performance Edge AI Vision on payload-sensitive platforms like drones and robotics, where every gram counts.

### Industrial-Grade Ruggedization

Unlike standard commercial electronics, the FantoVision systems are built to withstand the rigors of industrial and outdoor deployment:

- **IP Ratings:**
  FantoVision20 (GigE/CL): Rated **IP53** (Protected against dust and spraying water).
  FantoVision40-CXP12: Rated **IP51** (Protected against dust and vertically falling drops).
- **Vibration & Shock:** The reinforced chassis and compact mechanical design support reliable operation in vibration-prone environments. The system has been **tested and deployed on UAV and drone platforms**, as well as on moving machinery and AGVs.
- **Industrial Temperature:** For extreme climates, the systems support an industrial temperature range, ensuring reliable operation in environments ranging from **freezing cold** warehouses to sweltering **outdoor installations**.

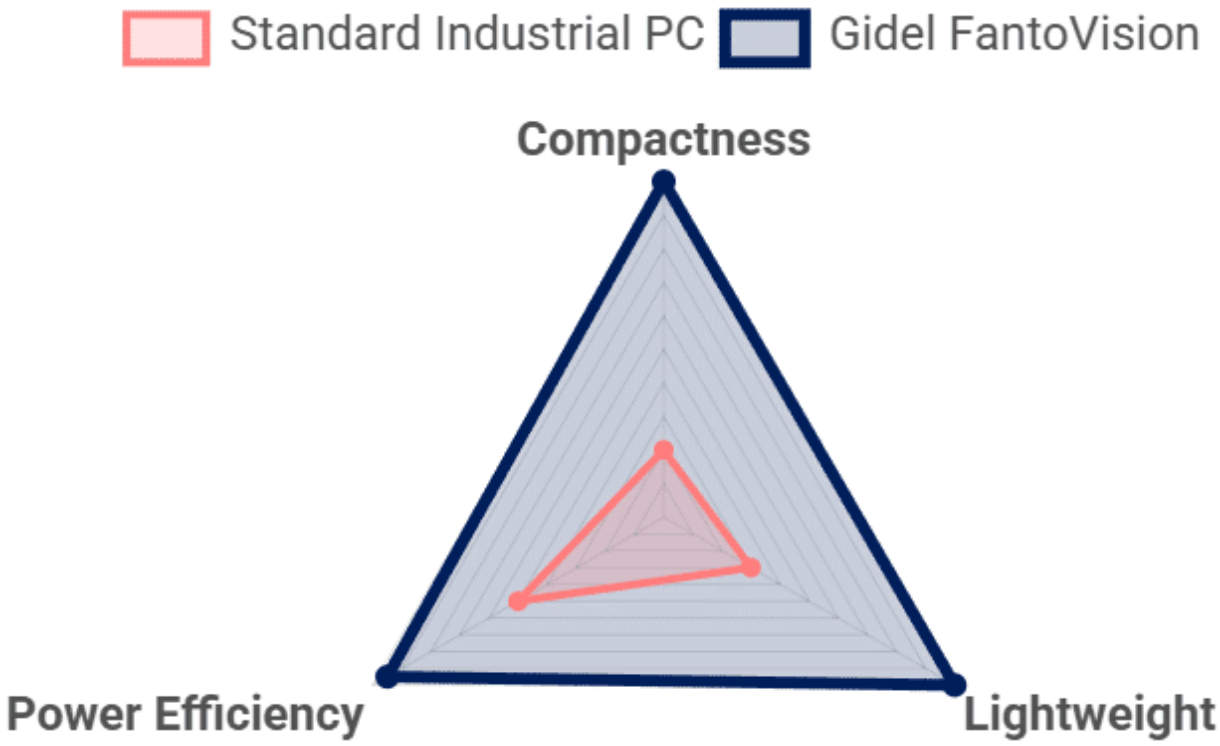


Figure 8: **SWaP Analysis -** A comparison of Size, Weight, Power (SWaP), and Performance. FantoVision outperforms traditional Industrial PCs in compactness and ruggedness while maintaining high AI performance.

## Conclusion: A New Standard for Edge AI Vision Architecture

The expanded FantoVision family marks an inflection point for Edge AI Vision and next-generation edge vision AI architectures. It acknowledges that different industries require specialized pipelines and that no single interface can serve all high-end applications.

Whether the goal is 50 Gb/s volumetric acquisition on a drone, long-distance 10GigE Vision streaming, or deterministic Camera Link timing, Gidel now provides targeted systems that preserve the Jetson thermal envelope, prevent CPU overload, and unlock sustained 157 TOPS performance in the field.

FantoVision breaks the Jetson I/O Wall and enables developers to transform pixels into intelligence without compromise.

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