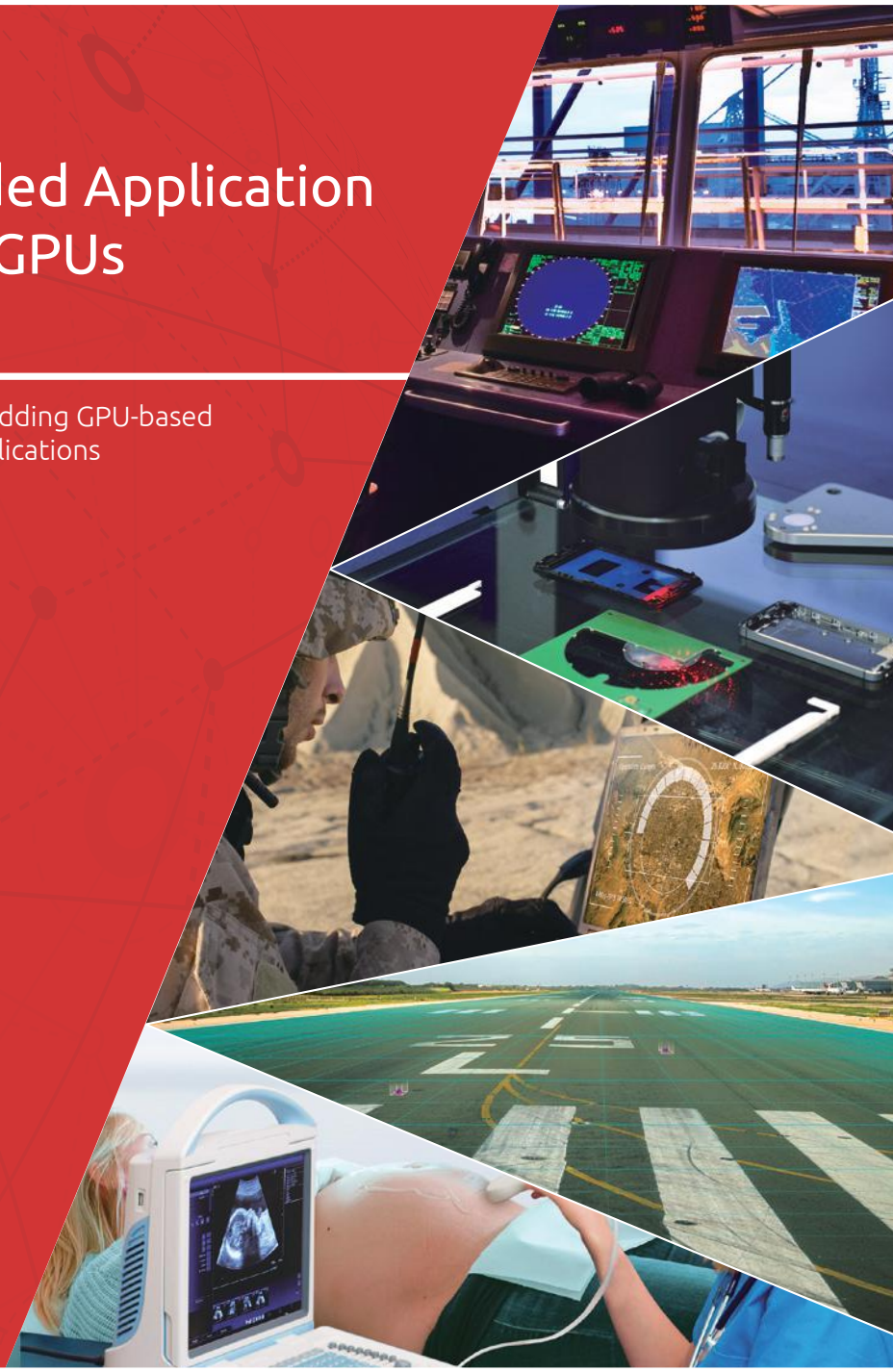
ADLINK
Leading EDGE COMPUTING

Solution Blueprint

Increasing Embedded Application Performance with GPUs

ADLINK products simplify the task of adding GPU-based embedded graphics to embedded applications



www.adlinktech.com

2019

Executive Summary

Embedded graphics enables system developers to boost the performance of a wide range of workloads, including medical imaging, image analysis, compute acceleration, and artificial intelligence (AI). Leveraging graphics processing units (GPUs), embedded graphics can be used to increase application speed and accuracy, as well as decrease latency. Many embedded system developers are using embedded graphics solutions in real-world applications, such as medical, manufacturing, and traffic management, along with other embedded segments (Figure 1).

Still, adding a GPU to an embedded system can be a complex task. One approach is to use graphics cards developed for the gaming application segment, which accounts for about a third of all GPUs;[1] however, these cards often do not satisfy key embedded system requirements, such as low system latency, long product availability, and power efficiency.

Addressing these issues, ADLINK products greatly simplify the process of adding GPUs to embedded designs. These products can satisfy a wide range of embedded requirements around performance, long life cycle, power consumption, and form factor.

This paper discusses how embedded graphics solutions are being used in embedded applications, and the way ADLINK products can simplify the design process for system developers, OEMs, and systems integrators.

Key Business Objectives

Embedded graphics solutions enable system developers, OEMs, and systems integrators to significantly improve signal and image processing performance in various application areas, including aerospace, maritime, medical, and industrial automation.

Business Challenges

Many commercial graphics solutions, such as those developed for gaming applications, have a relatively short lifecycle due to users' desires for the latest and greatest graphics technology. When embedded solution providers implement these commercial graphics solutions, they may be forced to conduct frequent product certifications, which can be time consuming and expensive. This situation is made more difficult by the relatively few vendors that offer embedded GPU-based computing solutions compared to general-purpose, CPU-based solutions.

These are just a few of the factors that may prompt system developers, OEMs, and systems integrators to consider integrating embedded GPU-based products from an experienced vendor, like ADLINK.

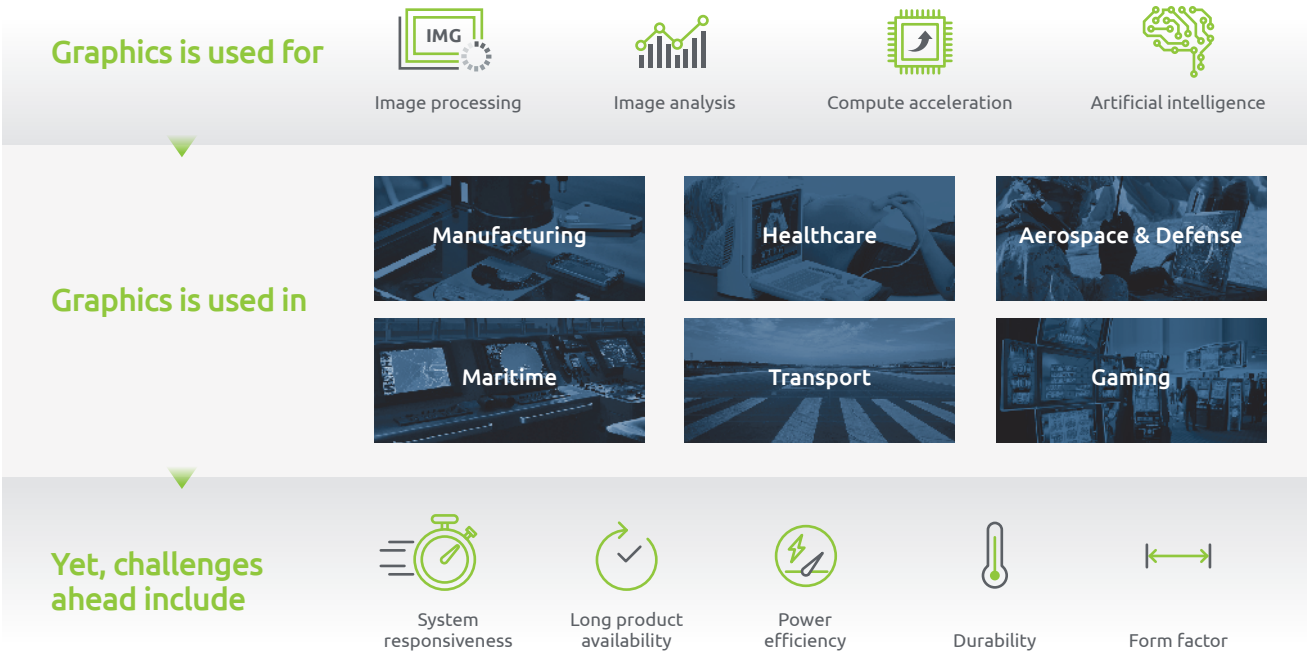


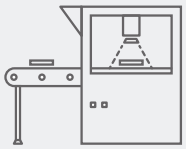
Figure 1. Graphics is widely used in vertical applications. Still, adding a GPU to an embedded system can be a complex task.

GPUs in Embedded Applications

ADLINK's Embedded Graphics offer high performance, high data bandwidth, power efficiency, and longevity support to enable greater value in many application areas, including:

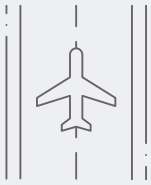
Manufacturing: Higher Inspection Quality

Automated optical inspection (AOI) systems are employed in large scale inspection of components, such as display panels, mobile phones, printed circuit boards, and many other products. Using embedded graphics to perform complex pattern matching, AOI algorithms compare production component images to a "golden sample" image to detect and classify defects, like missing components or solder joints. As a substitute for manual inspection, AOI can deliver higher levels of throughput and improved inspection quality.



Aerospace: Safer Airports

In order to maintain flight safety, airports need to frequently inspect runways for garbage and other debris as small as two centimeters, a procedure that can take hours when done manually. Alternatively, AOI can be used to greatly decrease inspection time, increase obstacle detection accuracy, and reduce the chances of flight delays. AI-based algorithms can identify birds in the sky that could potentially collide with planes and damage them.



Maritime: Better-Informed Navigation

Navigators of marine vessels plot their course using electronic chart display and information systems (ECDIS) to help them avoid known obstacles. Unknown obstacles can be seen in images created by radar, depth sounders, and other sensors. Embedded graphics can then be used to stitch ECDIS and sensor images together in order to provide a comprehensive panoramic view of nautical information and to display obstacles intelligibly.

Healthcare: Easier Ultrasound Operation

A portable ultrasound device is an important medical diagnostic tool, providing the ability to quickly assess a patient's condition at the point-of-care. Delivering a fast diagnosis is extremely important, and embedded graphics solutions help by increasing image processing speed and accuracy. Embedded graphics solutions can be designed into mobile applications that require low power and a small footprint.

Increasing Embedded Graphics Performance

A common theme in the previous embedded application examples is the need to quickly move external data from sensors and other sources to the GPU for processing. ADLINK achieves this by implementing remote direct memory access (RDMA), a feature of NVIDIA GPUDirect™ technology in NVIDIA® Quadro® GPUs that can boost data throughput by approximately 80 percent (3.6 to 6.5 gigabytes per second). RDMA gives external data sources direct access to the GPU's external memory, as shown on the left side of Figure 2. Without this feature, data would be copied into a CPU's memory (red lines on right side of Figure 2) before reaching the GPU, which needlessly increases data transmission delay and latency.

As an NVIDIA Quadro Embedded Partner with extensive experience in embedded applications, ADLINK is well qualified to provide system developers with solutions using GPUDirect, enabling them to tap into the power of embedded graphics and AI.

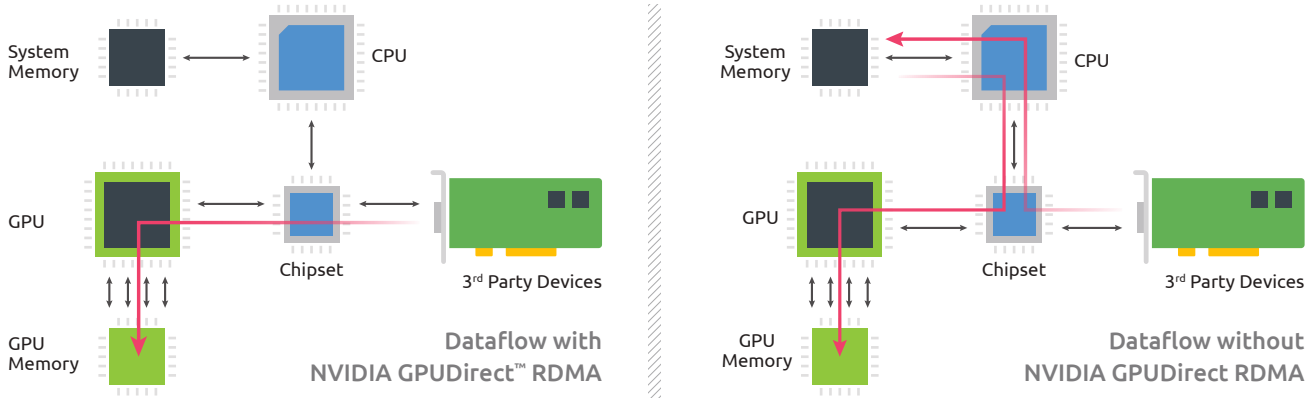


Figure 2. NVIDIA GPUDirect™ example[2]

ADLINK GPU-Powered Solutions

With ADLINK's portfolio of GPU-based solutions and computing platforms, system developers, OEMs, and systems integrators can more easily add embedded graphics to their applications:

ADLINK Embedded Graphics

ADLINK offers two families of embedded graphics products that are an ideal fit for high-resolution, multi-display installations for centralized control and monitoring and high-performance application processing. Mobile PCI Express Modules (MXMs) are well-suited for size, weight, and power (SWaP) constrained applications, like portable ultrasound, airborne radar, and aerial infrared imaging.

PCI Express graphic (PEG) cards connect via a common interface and are easy to integrate and use in many embedded market segments, such as healthcare (magnetic resonance imaging (MRI) and computed tomography (CT)), industrial automation (AOI inspection), and telecom (multi-access edge computing).

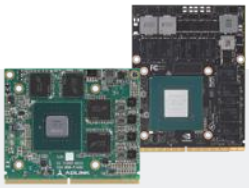
System Components for Embedded Graphics Integration

ADLINK Matrix compact fanless embedded computers provide an optimized, highly-available computing platform with expandability options, including the MXM cards previously discussed. The fanless platforms come in a compact size and support a wide operating temperature range, 5 Grms vibration, and cable-free durable structure for use in harsh environments. For applications in less challenging settings, DLAP platforms support performance-hungry workloads (e.g., deep learning) with active cooling for applications requiring very high levels of computing in a limited space (Figure 3).

For solution developers looking for expandable building blocks (Figure 4), ADLINK configurable embedded computers can consolidate highly-parallel graphics computing, motion control, and data acquisition through add-on cards. For applications demanding even greater scalability, ADLINK offers highly configurable motherboards and rackmount industrial chassis that provide an enclosure for ADLINK's large family of industrial ATX motherboards. The boards feature multiple PCIe/PCI/LAN/USB 3.0, enable immediate multi-tasking deployment, and balance performance and expandability.

Reduce Embedded Graphics Design Effort

System developers, OEMs, and systems integrators can more easily deploy embedded graphics with help from ADLINK's large portfolio of computing products that can be designed into a wide range of form factors. Combining its strong expertise serving embedded developers and its close partner relationship with NVIDIA, ADLINK is delivering high-performance, long-life embedded graphics solutions to many market segments.



MXM-Compatible Systems

MVP-5100-MXM Integrated Fanless Embedded Computer
Powerful compact fanless system with MXM graphics and rich I/O

Coming Soon Fanless

MVP-6100-MXM Expandable Fanless Embedded Computer
Function expansion options with MXM graphics, AI frame grabber, and data acquisition/motion control card

Coming Soon Expansion

DLAP-3000-CFL Compact Embedded Computer
Compact system with MXM graphics, socket-type CPU, and fan

Coming Soon Fan

Figure 3. ADLINK MXM-compatible systems

PEG-Compatible Systems and Boards

New MVP Series Fanless Embedded Computer

Function expansion options with PEG/ data acquisition/motion control card and AI frame grabber

Coming Soon | Expansion

MVP Series Expandable Fanless Computer

Function expansion options with PEG/ data acquisition/motion control card and AI frame grabber

Fanless | Expansion

MXC Series Expandable Fanless Computer

Function expansion options with PEG/ data acquisition/motion control card and AI frame grabber. Ruggedness with extended temperature range support

Fanless | Expansion

IPC Series Rackmount Computer

High-mix PCI and PCIe slots to consolidate highly-parallel graphics computing, motion control, and data acquisition through add-on cards

ATX Motherboard

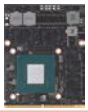
Highly configurable motherboards to consolidate highly-parallel graphics computing, motion control, and data acquisition through add-on cards

Mini-ITX Embedded Board

Form-fit-function design supports PEG card, AI frame grabber, data acquisition, and motion control cards

Figure 4. ADLINK PEG-compatible systems and boards

1. "GPU Market to cross $80bn by 2024: Global Market Insights, Inc.," January 29, 2019, https://www.globenewswire.com/news-release/2019/01/29/1706699/0/en/Graphic-Processing-Unit-GPU-Market-to-cross-80bn-by-2024-Global-Market-Insights-Inc.html.
2. Accelerating High Performance Computing with GPUDirect RDMA, http://on-demand.gputechconf.com/gtc/2013/webinar/gtc-express-gpudirect-rdma.pdf.

Model Name	EGX-MXM-P1000	EGX-MXM-P2000	EGX-MXM-P3000	EGX-MXM-P5000
				
Graphic Core				
Graphic Architecture	NVIDIA® Pascal™ GP107		NVIDIA® Pascal™ GP104	
GPU	Quadro® P1000	Quadro® P2000	Quadro® P3000	Quadro® P5000
Display Output	4x DisplayPort 1.4 digital video outputs Support for High Dynamic Range (HDR) video 4K at 120Hz or 5K at 60Hz with 10-bit color depth		Up to 1 internal display plus 5 external display outputs 5x DisplayPort 1.4 digital video outputs (DP++) 1x HDMI, 2x DVI, 1x eDP	
Signal Interface	MXM 3.1, PCI Express Gen3 x16 support			
GPGPU Computing				
CUDA Support	512 CUDA® cores, 1.8 TFLOPS SP Peak	768 CUDA® cores, 2.3 TFLOPS SP Peak	1280 CUDA cores, 3.9 TFLOPS peak FP32 Performance	2048 CUDA cores, 6.4 TFLOPS peak FP32 performance
Memory	GDDR5 4GB memory, memory width: 128-bit, bandwidth: 96 GB/s	GDDR5 4GB memory, memory width: 128-bit, bandwidth: 96 GB/s	GDDR5 6GB memory, memory width: 192-bit, bandwidth: 168.2 GB/s	GDDR5 16GB memory, memory width: 256-bit, bandwidth: 192.2 GB/s
Compute API	CUDA Toolkit 8.0, CUDA Compute version 6.1, OpenCL™ 1.2		CUDA Toolkit 8.0, CUDA Compute version 6.1, OpenCL™ 1.2, Direct Compute	
Graphic API	DirectX® 12, OpenGL 4.5, Vulcan 1.0		DirectX® 12, OpenGL 4.5, Vulkan 1.0 Shader Model 5.1	
NVIDIA Technology	-	-	NVIDIA® Mosaic Technology, NVIDIA® nView® Display Management Technology	NVIDIA® VR Ready, NVIDIA® Mosaic Technology, NVIDIA® nView® Display Management Technology
Mechanicals				
Dimensions	82 (W) x 70 (D) x 4.8 (H) mm		87 (W) x 105 (D) x 4.8 (H) mm	
Locking Mechanism	Standard MXM 3.1 Type A		Standard MXM 3.1 Type B	
Environmental				
Operating Temp.	Standard: 0˚C to 55˚C, ETT: -40˚C to 85˚C		0 to 55˚C	
Storage Temp.	-40˚C to 85˚C		-40˚C to 125˚C	
Module Power Consumption	48W	58W	75W	100W
SW Support				
OS Support	Windows 7/10 & Linux drivers, 64-bit			

Model	Quadro-E PEG P620	Quadro-E PEG P1000	Quadro-E PEG P2000	Quadro-E PEG P4000
				
Graphic Core				
Graphic Architecture	NVIDIA® Pascal™ GP107		NVIDIA® Pascal™ GP106	NVIDIA® Pascal™ GP104
GPU	Quadro® P620	Quadro® P1000	Quadro® P2000	Quadro® P4000
Display Output	4x mDP 1.4, 4096x2160 @ 60Hz/5120x2880 @ 60Hz HDCP 2.2 support * VGA/DVI/HDMI support via adapter/connector/bracket			4x DP 1.4, 7680×4320 @120 Hz/ 7680×4320 @ 60 Hz/ 5120×2880 @ 60 Hz HDCP 2.2 support * VGA/DVI/ HDMI support via adapter/ connector/bracket
Signal Interface	PCI Express Gen3 x16 support			
GPGPU Computing				
CUDA Support	512 CUDA cores, 1.38 TFLOPS peak FP32 performance	640 CUDA cores, 1.89 TFLOPS peak FP32 performance	1024 CUDA cores, 3.0 TFLOPS peak FP32 performance	1792 CUDA cores, 5.3 TFLOPS peak FP32 performance
Memory	GDDR5 2GB memory, memory width: 128-bit, bandwidth: 80 GB/s	GDDR5 4GB memory, memory width: 128-bit, bandwidth: 80 GB/s	GDDR5 5GB memory, memory width: 160-bit, bandwidth: 130 GB/s	GDDR5 8GB memory, memory width: 256-bit, bandwidth: 243 GB/s
Compute API	CUDA Toolkit 8.0, CUDA Compute version 6.1, OpenCL™ 1.2, Direct Compute			
Graphic API	DirectX® 12, OpenGL 4.5, Vulkan 1.0 Shader Model 5.1			
NVIDIA Technology	NVIDIA® Mosaic Technology, NVIDIA® nView® Display Management Technology			
Mechanicals				
Dimensions	2.713" × 5.7", single slot	2.713" × 5.7", single slot	4.4" H x 7.9" L, single slot	4.4" H x 9.5" L, single slot
Weight	129g	129g	260g	475g
Environmental				
Operating Temp.	0 to 55˚C			
Storage Temp.	-40˚C to 75˚C			
Module Power Consumption	40W	47W	75W	105W
SW Support				
OS Support	Windows 7/10 & Linux drivers, 64-bit			

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