DRIVE Platform For Developers

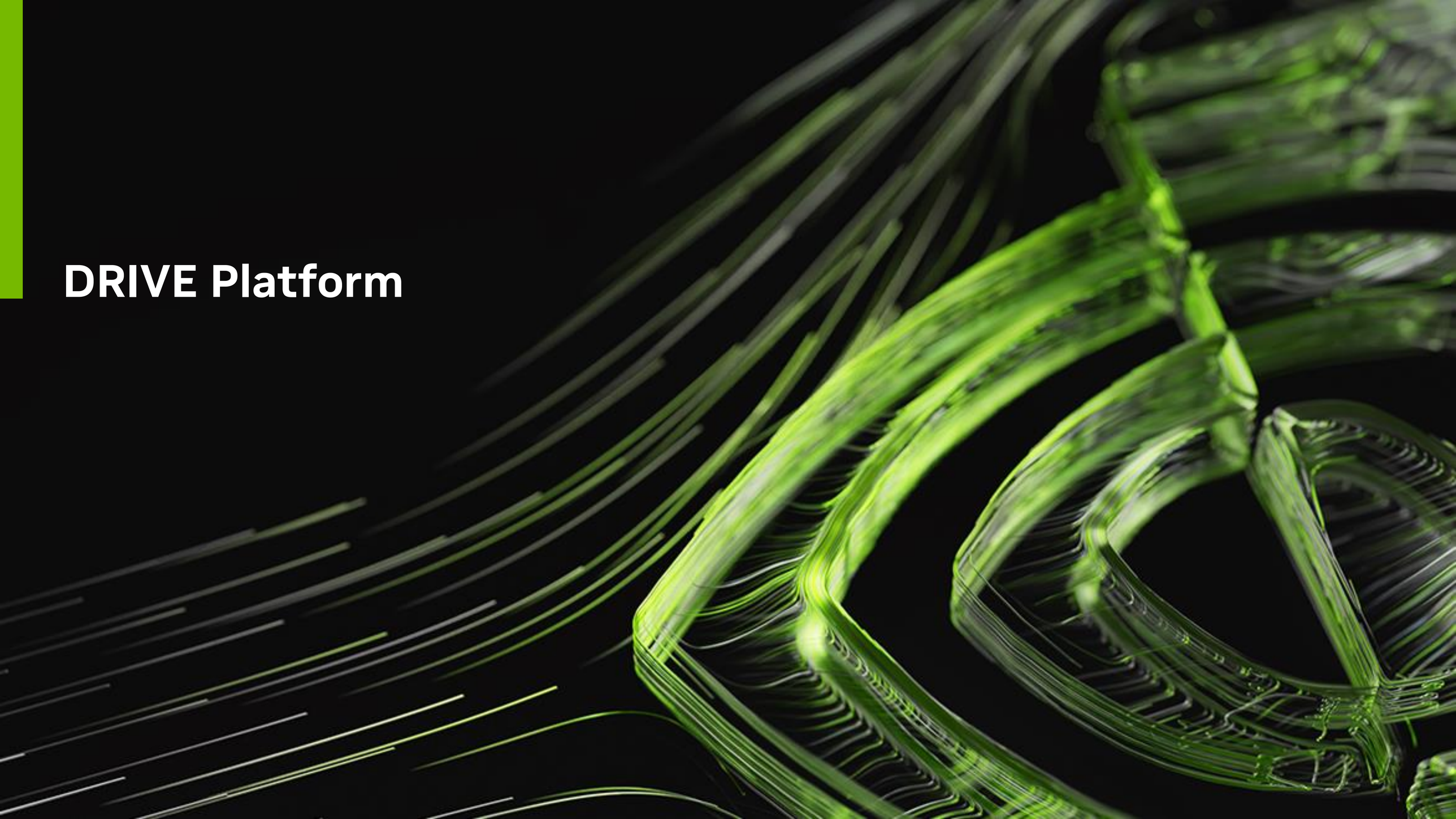
March 2023

Overview

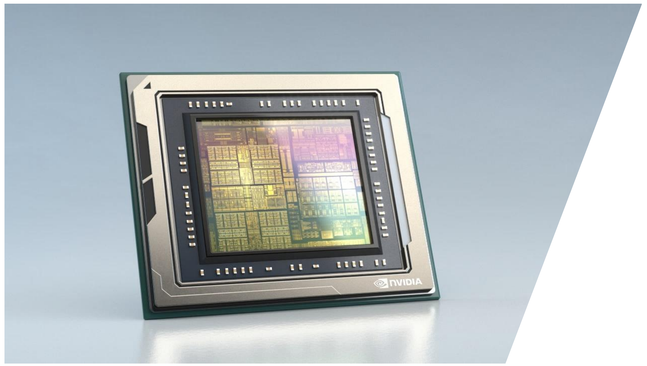
- DRIVE Platform
- DRIVE OS

Link to Latest Online PDF Version

DRIVE Platform



NVIDIA DRIVE End-to-End Solutions for Autonomous Vehicles



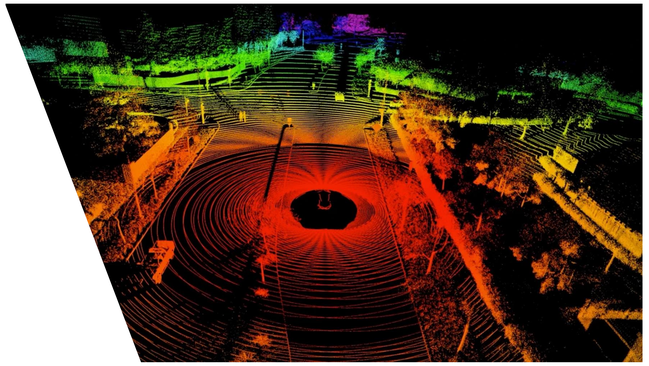
DRIVE Orin SoC

Software-Defined Platform

DRIVE AGX Orin DevKit

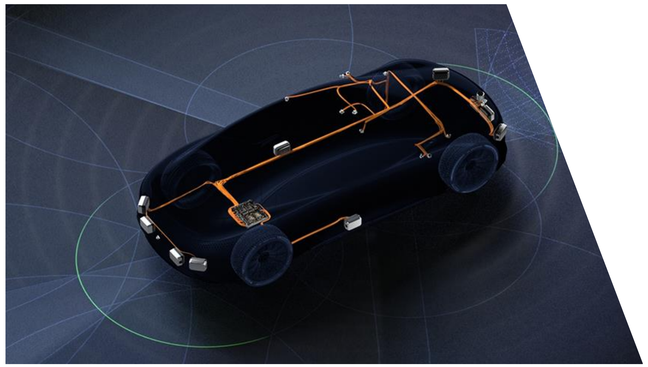
High-Performance
Development Platform

DRIVE AGX Developer Program



DRIVE OS

AV Software Foundation
OS, CUDA & DriveWorks



DRIVE Hyperion

Reference Architecture
with Sensor Specification

DRIVE Sim

AV Development and Validation Tools
Built on NVIDIA Omniverse

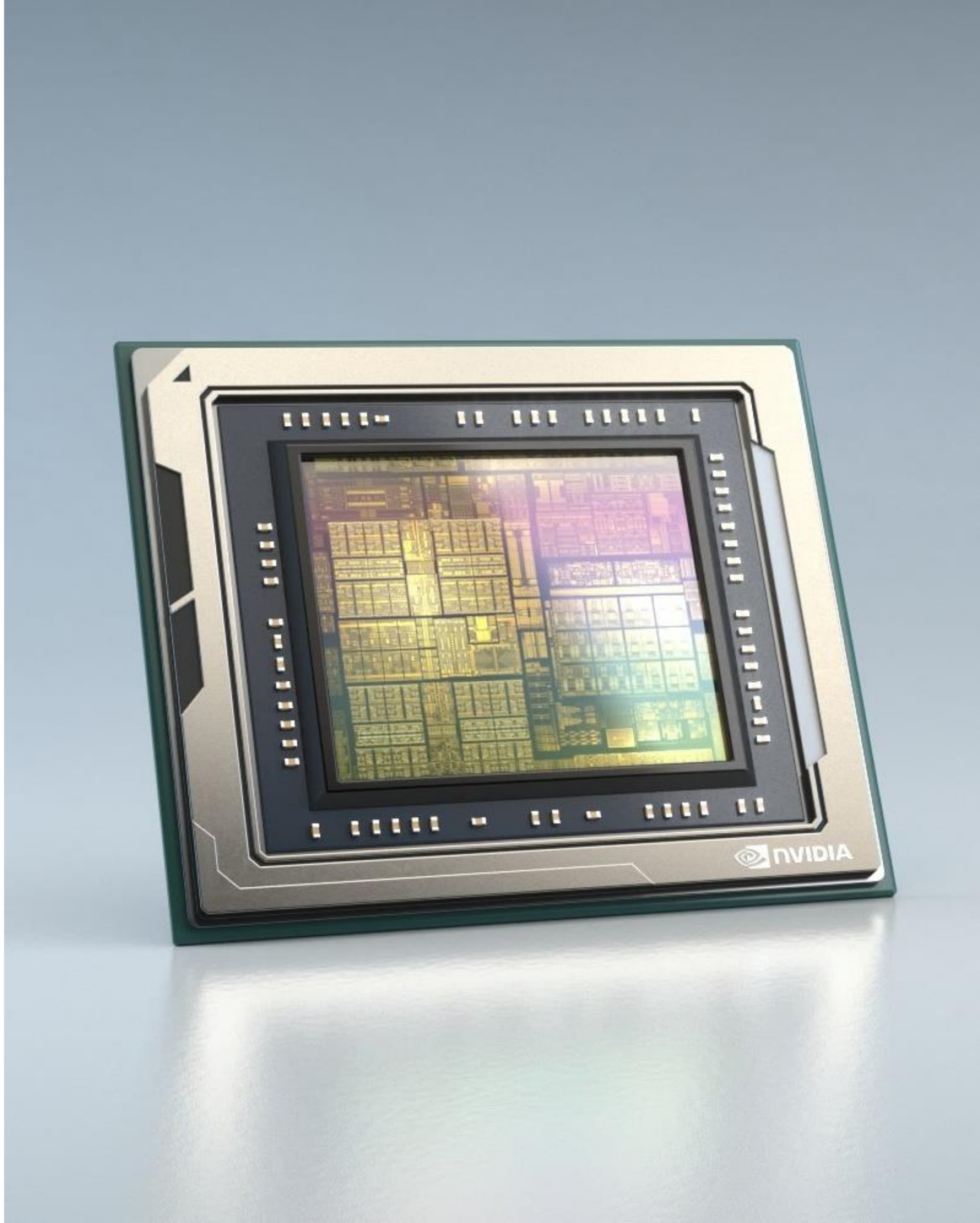
Early Access Program

DRIVE Orin SoC

Advanced, software-defined platform for autonomous vehicles

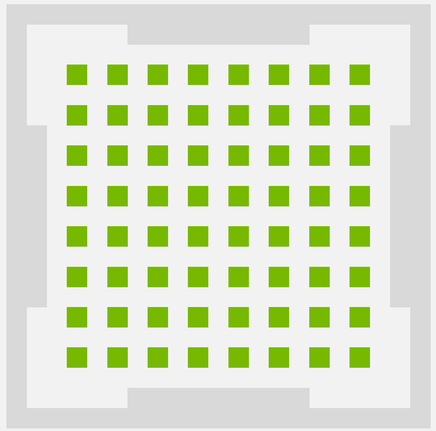
- **254 INT8 TOPS - CUDA Tensor Core GPU + DLA**
- 12 A78 (Hercules) ARM64 CPUs
- 205 GB/s memory bandwidth
- 4 R52 Lock-step Pairs Integrated Safety Island ASIL-D
- ISO 26262 (FUSA) ASIL-B Chip | ASIL-D Systematic

- Hardware Accelerators:
  - Deep Learning Accelerators (DLA)
  - Programmable Vision Accelerator (PVA)
  - Optical Flow Accelerator (OFA)



DRIVE Orin Hardware Accelerators

Optimal efficiency for diverse workloads



Ampere GPU

Accelerates All Parallelizable Workloads

Maximum Performance and Flexibility

Improvements for Orin:
Increased Performance & Enhanced Tensor Cores

167 INT8 DL TOP/s
83.5 FP16 DL TOP/s

2x Gen2 DLA

Accelerates Deep Neural Networks

Optimal Performance/Watt for DNNs

Improvements for Orin:
Depthwise Convolution & Hardware Scheduler

87 INT8 DL TOP/s total

Gen2 PVA*

Accelerates Computer Vision Algorithms

Highly Specialized, Minimal Power Consumption

Improvements for Orin:
Optical Flow Accelerator & More Performance

2048 INT8 GMAC/s

*Accessible via DriveWorks Image Processing Library

Self-Driving Hardware And Software Development Kit

Open & scalable platform purpose built for automotive

DRIVE AGX Orin DevKit

DRIVE OS – AV SW Foundation
Auto-grade Silicon & IO
254 TOPS | 200W

Available Now

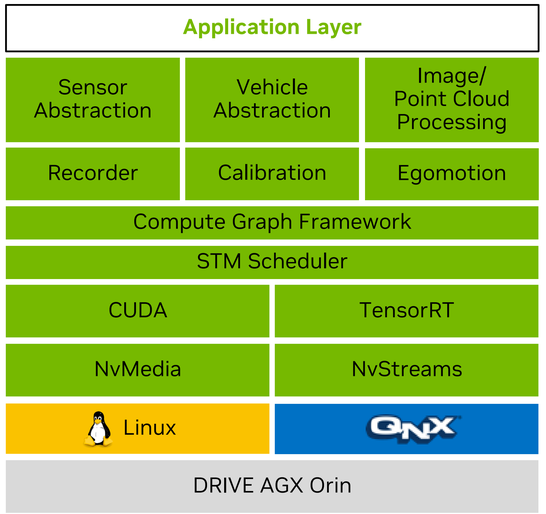
Directly from NVIDIA and
Authorized Distributors Like Arrow

Rich IO for Development, Sensors and Vehicle Bus

- Vehicle Bus, GMSL, Ethernet, PCIe, USB, DisplayPort, Wi-Fi, Bluetooth
- ISO 26262 compliant sensors supported via partners

Software Included

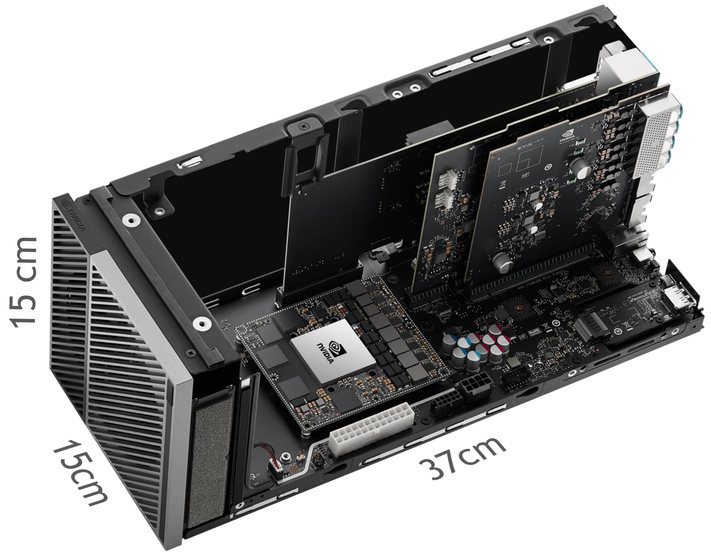
- DRIVE OS with DriveWorks
- Middleware, tools and algorithms
- ISO 26262 safety certifiable DRIVE OS
  QNX, drivers, and platform APIs



Safe and Performant Compute Platform

- Orin SoC with CUDA Tensor Core GPU and 12 A78 (Hercules) ARM64 CPUs
- Architected for safety, production boards available via Tier1s

Spec Overview



Components		
Orin SoC	GPU	Integrated CUDA Tensor Core GPU
	Accelerators	Deep Learning Accelerators (DLA) Programmable Vision Accelerator (PVA) Optical Flow Accelerator (OFA)
	CPU	12 A78 (Hercules) ARM64 CPUs
Safety MCU		Infineon Aurix TC397
Storage		256 GB UFS
Power Supply		Built-in
Wiring Harness		Additional Accessory

Performance	
DL Inference TOPS (INT8)	254 TOPS
Memory Bandwidth	205 GB/s
System RAM	32GB LPDDR5 at 3200 MHz

Operating Parameters	
Temperature	0 to 45°C
Power TDP	200W
Voltage	9V to 16V (Static), 7V to 32V (Transient)

Auto-Grade and Development Interfaces

Convenient bench development | Reliable in-vehicle operation

Ethernet ~30Gb/s total	2x 10x 6x	10 GbE 1 GbE 100 MbE	1 H-MTD*, 1 RJ45 9 H-MTD*, 1 RJ45 MATEnet*
Camera	16x	GMSL	MATEAX GMSL 1/2*
USB	2x 2x	USB 3.2 USB 2.0	Type C Type A
PCIe**	1x	PCIe x8	Mini-SAS
Video Out	1x		DisplayPort 1.4
Wiring Harness (Opt. Accessory)	6x	CAN*	Wiring Harness Connector (DevKit) DB9 (Wiring Harness)
	1x	LIN*	
	1x	FlexRay*	
	12x	USS*	

*Auto-grade connectors **Can be used to connect Orin DevKits

Supported Sensors

Sensors for DRIVE Orin Ecosystem Partners

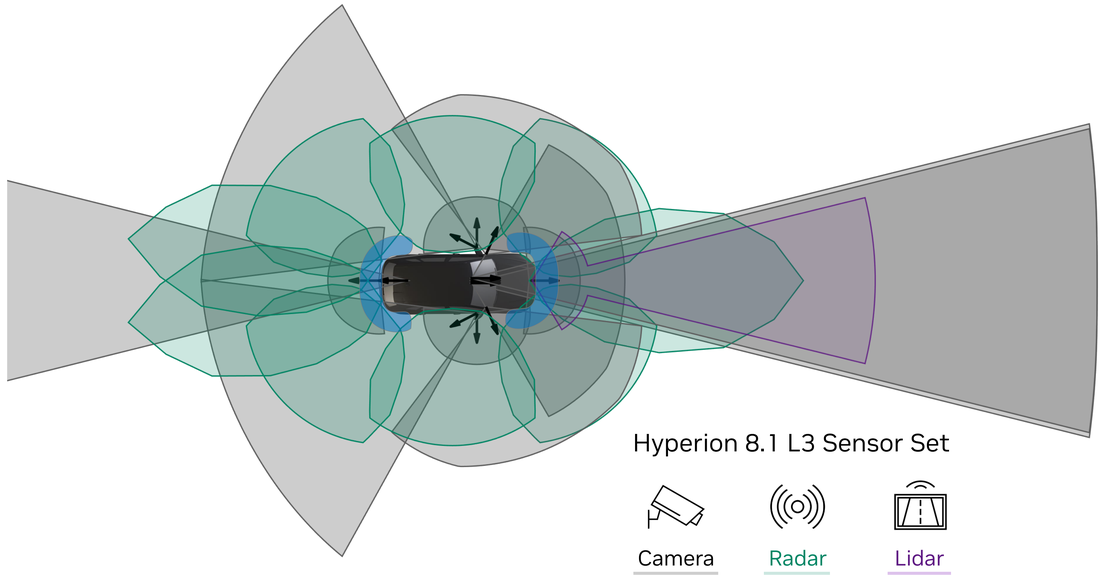
- Sensors supported for ecosystem developers
- See DRIVE AGX Orin Sensors and Accessories for details

Ecosystem Sensor Vendors

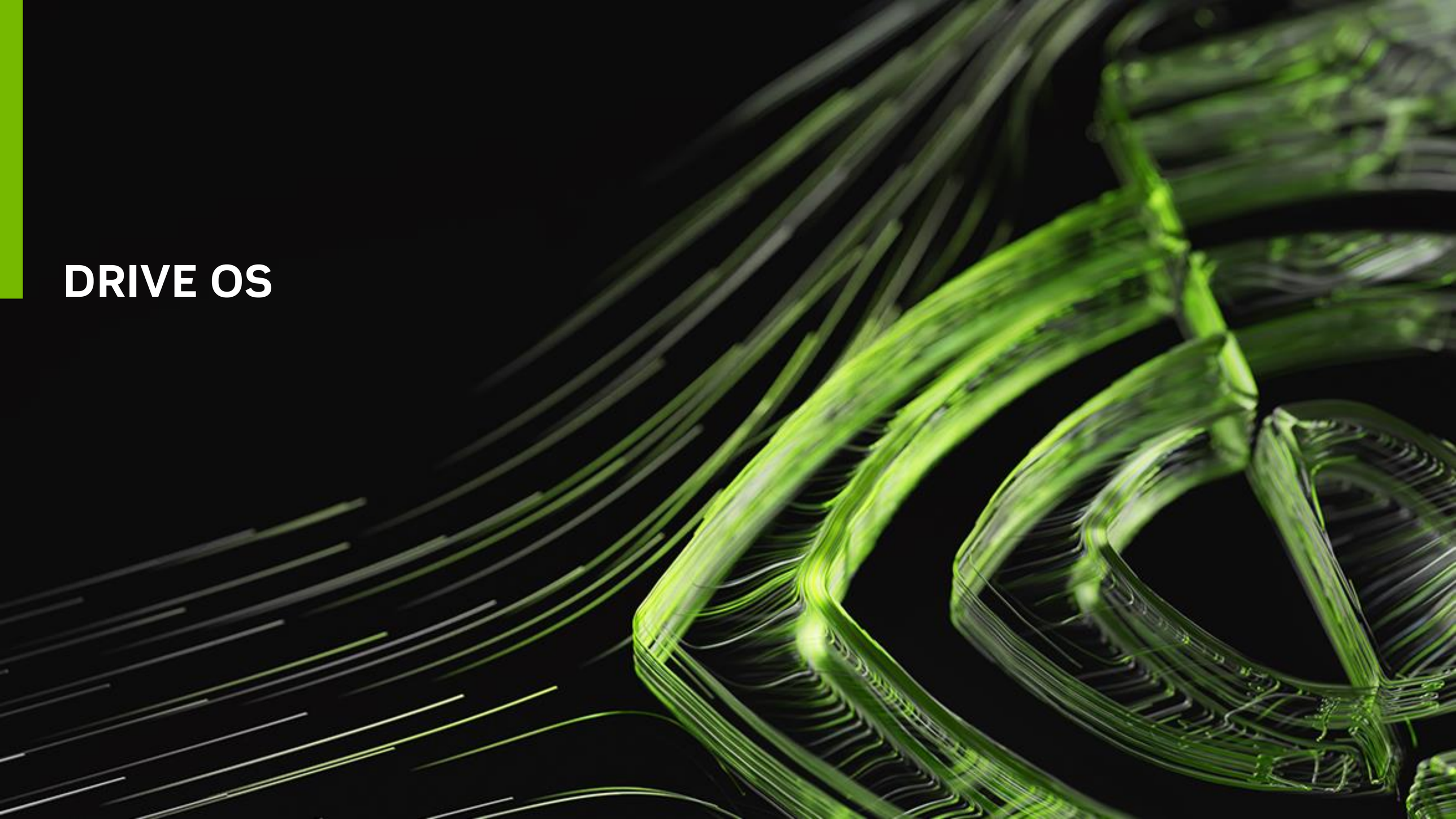
Cameras	Lidars	Radars
• SONY • Leopard • Omnivision • Entron • On Semiconductor • Sekonix • Quanta	• Velodyne • Luminar • Hesai • Ouster • Innoviz • AEVA	• Continental • Arbe

Hyperion 8.1 Reference Architecture

- Hyperion 8.1 is NVIDIA's automotive grade L2+ / L3 AV production architecture
- See DRIVE Hyperion 8.1 Sensors and Accessories for details



DRIVE OS

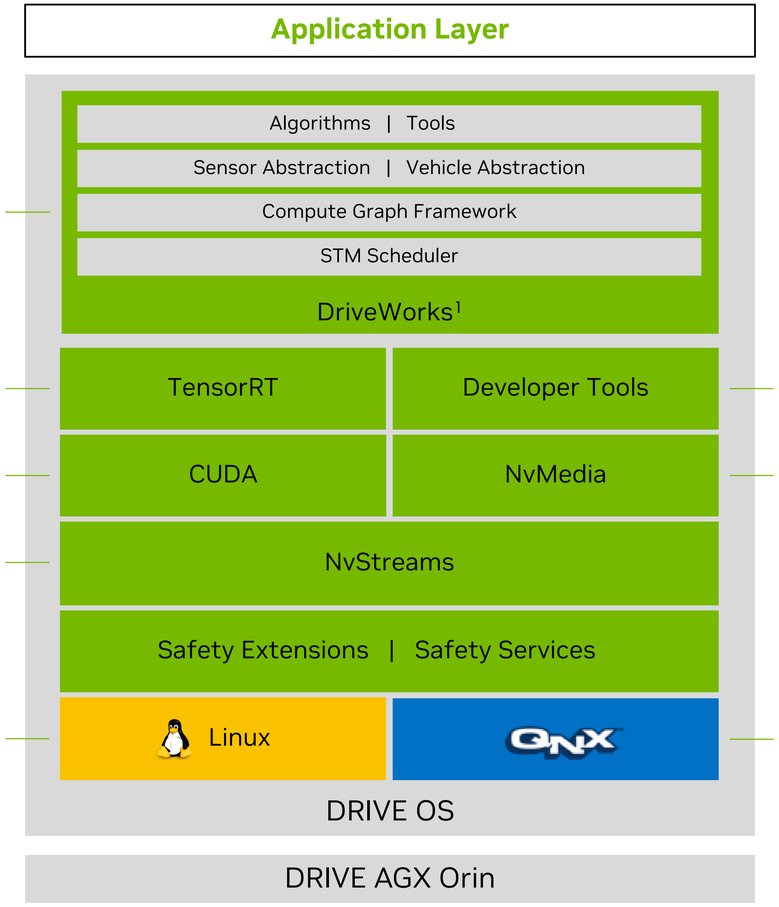


DRIVE OS – NVIDIA's AV Software Foundation

Operating system, foundational libraries, and tools for cutting-edge automotive applications

Automotive Standards Compliance		ISO 26262 & ASPICE Compliant (QNX) ISO / SAE 21434 Compliant
Support for Complex, High-performance AV Software Stacks		Optimal Utilization of Orin's HW Accelerators Minimal Data Copies via NvStreams
Ease of Programming		Smooth transition from X86 to DRIVE OS Linux Safety-compliant CUDA and TensorRT

DRIVE OS Components



Auto-grade Middleware
Accelerated Algorithms
Versatile Tools

High-Performance Deep Learning Inference

GPU-Accelerated Programming

High-Speed Data Transport between Threads, Processes, VMs
Efficient Buffer Sharing Minimizes Copies

Safety Extensions for Production Use
Eases Transition from X86

Nsight Visual Studio Code Edition – IDE
Nsight Systems – System Tracing
Nsight Compute – Compute Profiling & Debugging
Nsight Graphics – Graphics Debugging & Profiling

Direct Access to Imaging Sensors and HW Accelerators

Safety Certifiable
APIs Consistent with Linux

Link to DRIVE OS Documentation

Link to DriveWorks Documentation

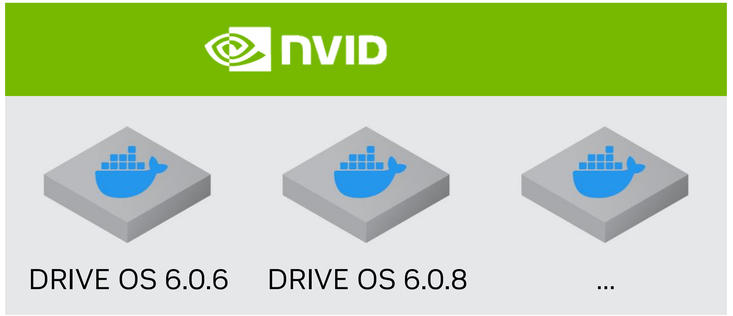
[1] For development only

New with DRIVE OS 6

Smoother development experience | All-new middleware features

DRIVE OS 6 New Features

- Host and target Docker support
- Linux safety extensions
- Chip-to-chip communication via NvStreams

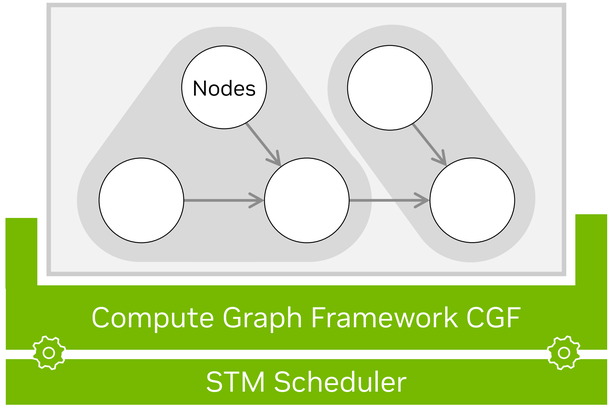


NGC is NVIDIA's Portal of Enterprise Services, Software, and Support for AI, Digital Twins, and High-Performance Computing

DriveWorks 5 New Features

DriveWorks becomes a full-fledged AV middleware:

- With Compute Graph Framework (CGF), applications can be expressed as graphs and nodes
- System Task Manager (STM) is a static, non-pre-emptive scheduler compiling an optimal schedule for CGF graphs



DRIVE OS 6 Software Components

Component	Version
Ubuntu Host Development Environment	**20.04**
Ubuntu Target Root File System[1]	
Linux Kernel[1]	**5.10**
Blackberry QNX SDP[2]	**7.1.1**
Blackberry QNX QOS[2]	**2.2**
QCC Toolchain	**8.3**
GCC Toolchain	**9.3**
C++ Feature set	**17**
DriveWorks[4]	**5.x**
CUDA Toolkit	**11.4**
NVIDIA UDA CUDA Driver[1] (x86)	**r470**
TensorRT	**8.x**[3]
cuDNN	**8.x**[3]
Vulkan	**1.2**
Wayland[1]	**1.18**
PKCS#11	**Y**

[1] Linux only, not available on QNX
[2] QNX only, not available on Linux
[3] Final version number TBD
[4] For development only

Why QNX for Safety?

Safety OS key selection criteria

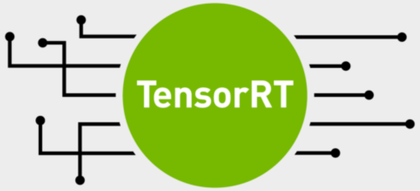
- ISO 26262
  - ASIL D certified RTOS
  - TCL3 qualified toolchain
- POSIX PSE52 standards certification
  - Requirement for CUDA support
- Common Unix heritage with Linux
  - Rich dependent library support

Hardware Accelerated Compute Engines

Open | Scalable | Seamless | End-to-end

CUDA

Parallel computing model for compute intensive applications

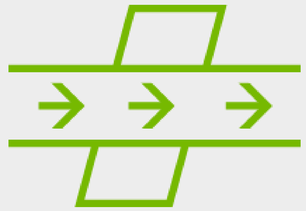


TensorRT

SDK for high-performance deep learning inference

NvMedia

Optimized API providing direct access to hardware accelerated compute engines and sensors, support Orin new Optical Flow Accelerator, DLA, AV1 encode & decode

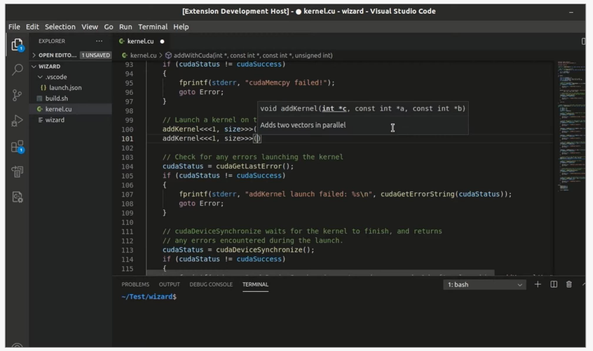


NvStreams

Highly efficient API enabling access to high-speed data transports, support over PCIe & Mellanox accelerated support across inter-ECU boundaries

Nsight Developer Tools

For GPU and CPU software debugging and profiling

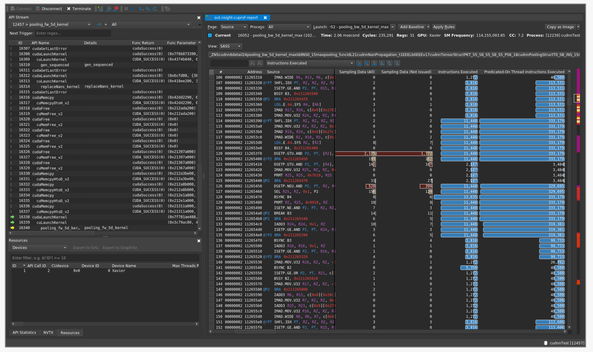


Nsight Visual Studio Code Edition

IDE GPU application development

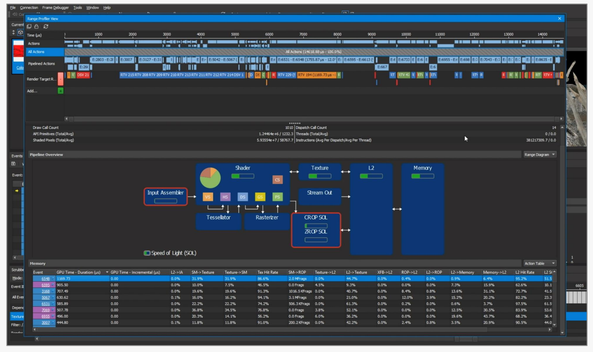
Nsight Systems

System trace



Nsight Compute

Compute profiling



Nsight Graphics

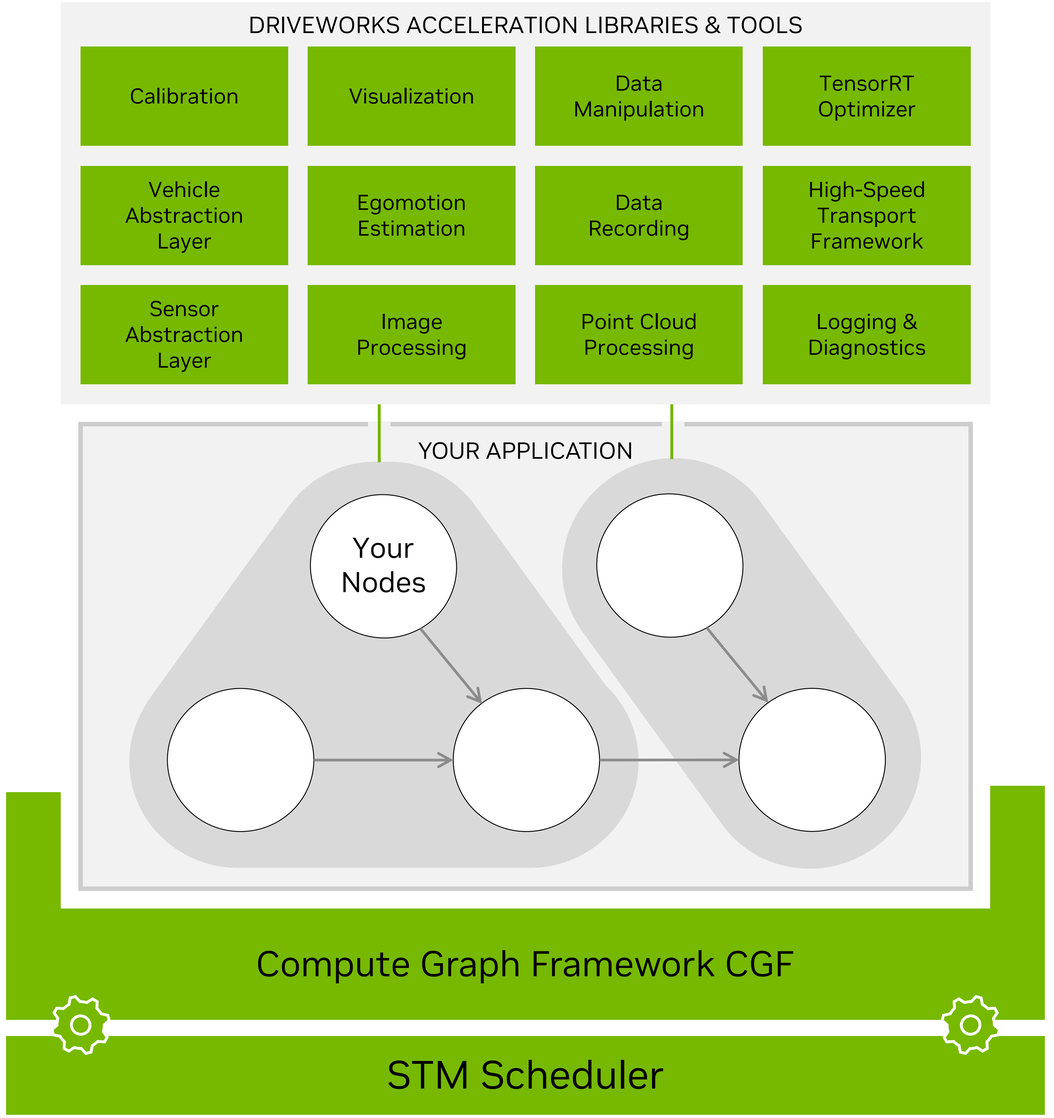
Graphics debugging & profiling

Maximized with NVTX source code instrumentation NVIDIA tools extension

DriveWorks — Comprehensive Middleware Solution

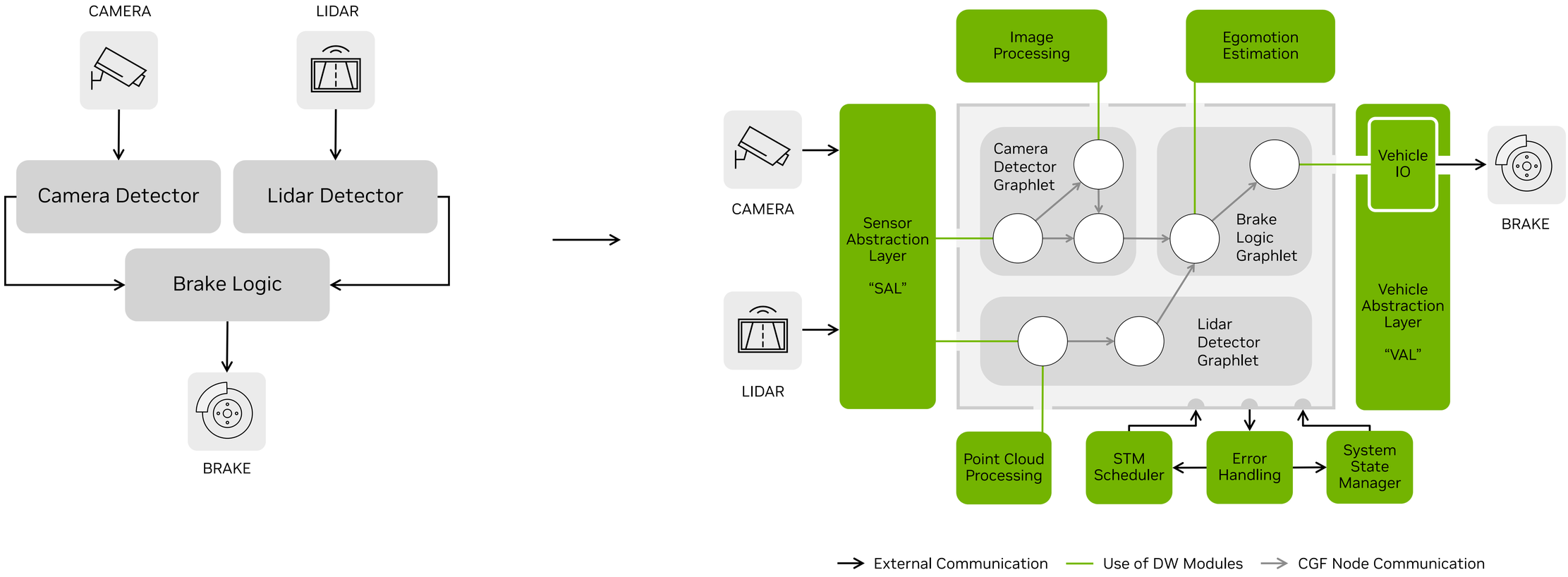
Rich Library of Algorithms and Tools
to accelerate your applications

Compute Graph Framework
to leverage deterministic scheduling



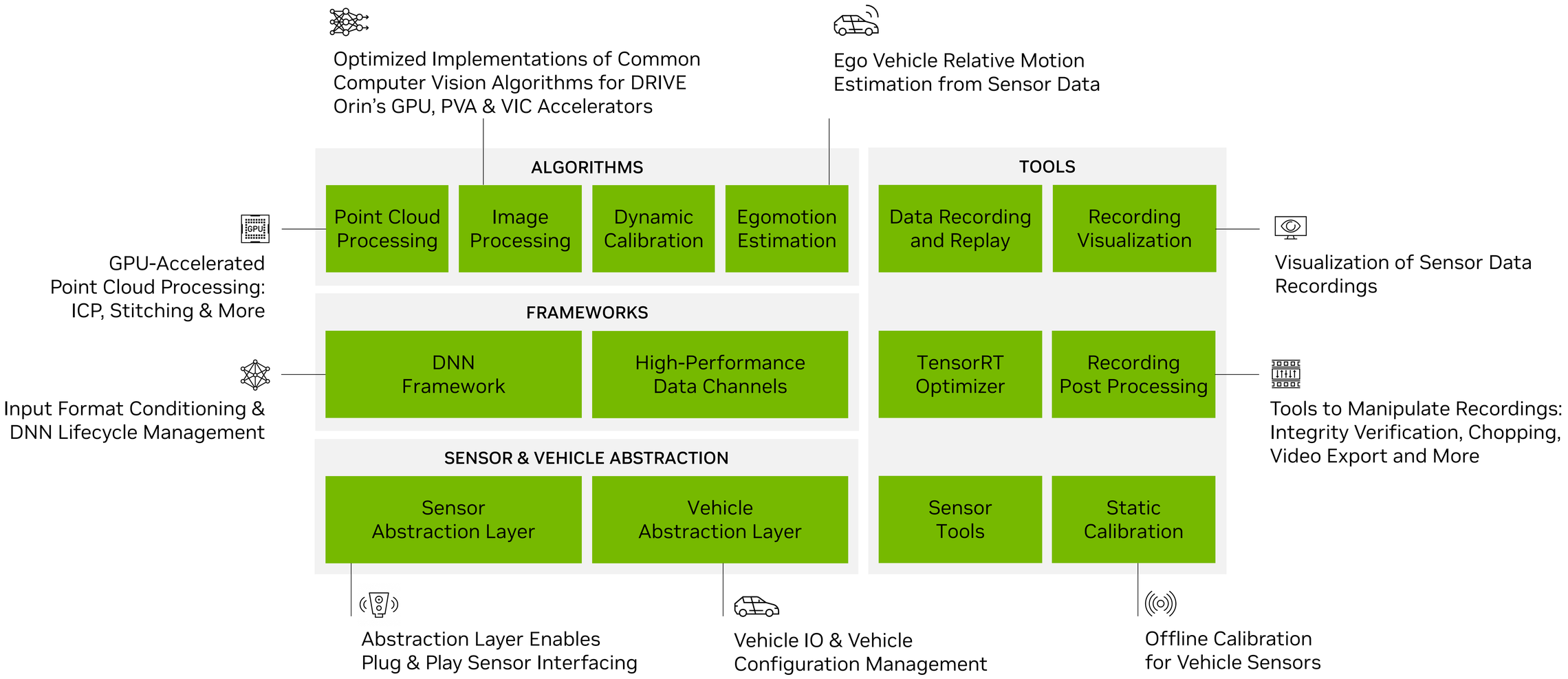
Exemplary Application as a Compute Graph

CGF enables structured and dependable software



DriveWorks Modules

A rich library of algorithms and tools to bootstrap AV development



Get Started with DRIVE SDK

Extensive documentation & training material available on NVIDIA Developer

Learn More

- Visit the DRIVE training page for webinars and other resources
- Check out information related to DRIVE Hyperion, DRIVE AGX Orin and DRIVE SDK

Get Access

- Join the DRIVE AGX SDK Program on NVIDIA Developer
- Read the docs for DRIVE OS and DriveWorks documentation
- Download DRIVE OS which includes DriveWorks, NvMedia, CUDA, cuDNN and TensorRT

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- Contact your distributor or NVIDIA's Automotive Team


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