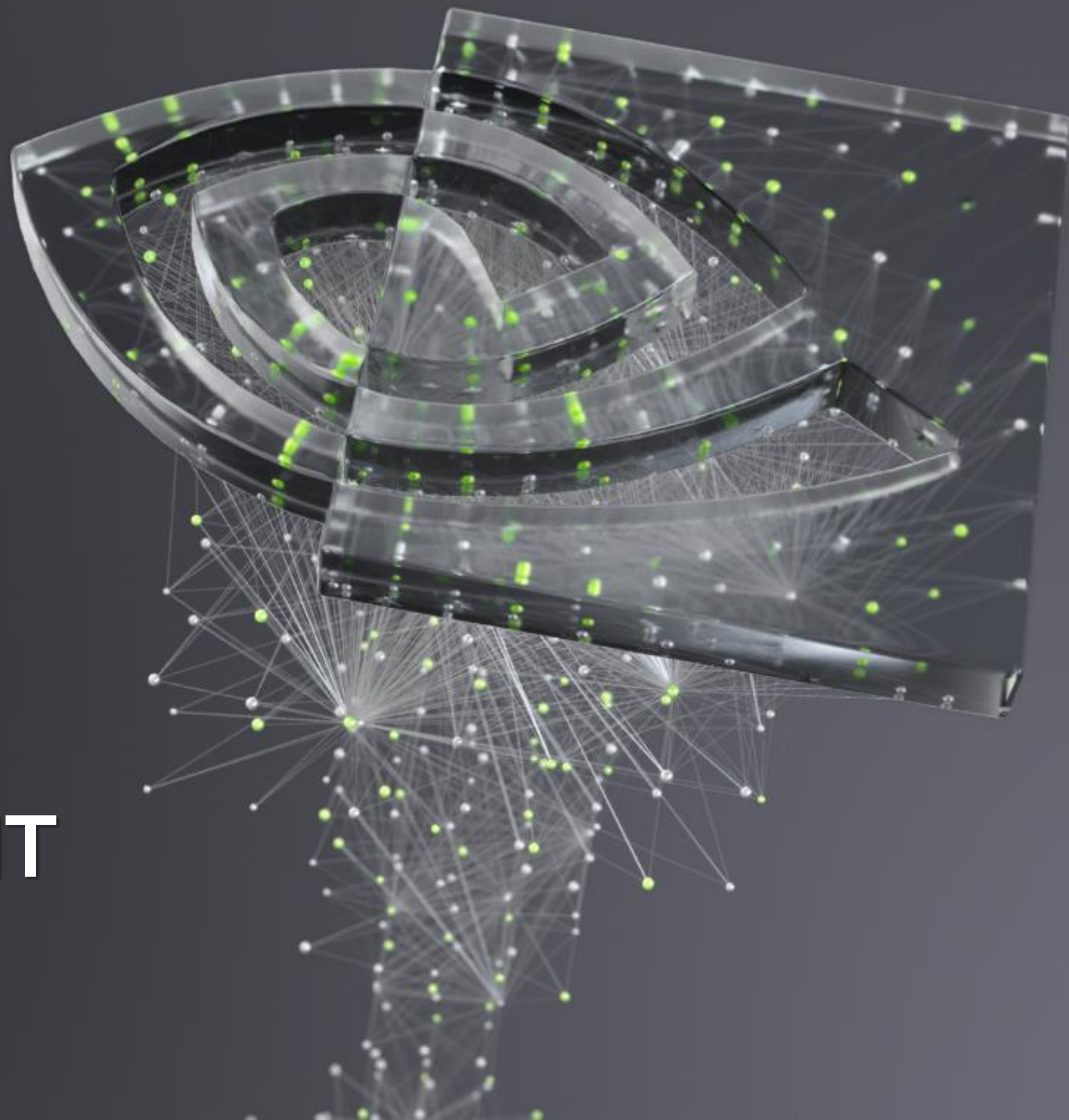




NVIDIA DRIVE SDK: THE FOUNDATION OF AV DEVELOPMENT

Varun Murthy | November 2021





AGENDA

DRIVE SDK Introduction

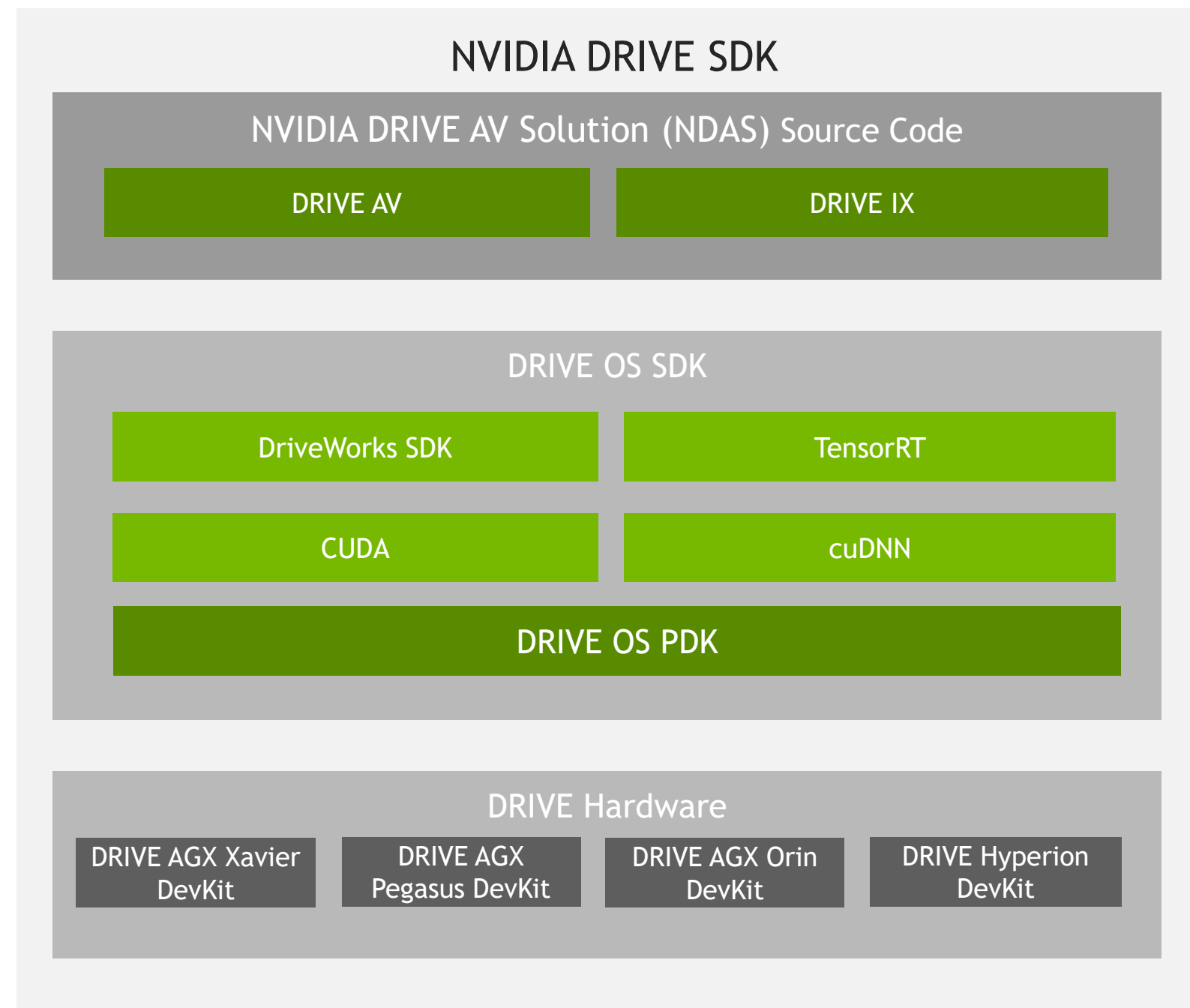
DRIVE OS Overview

DriveWorks Overview

Demo - New Development Paradigm

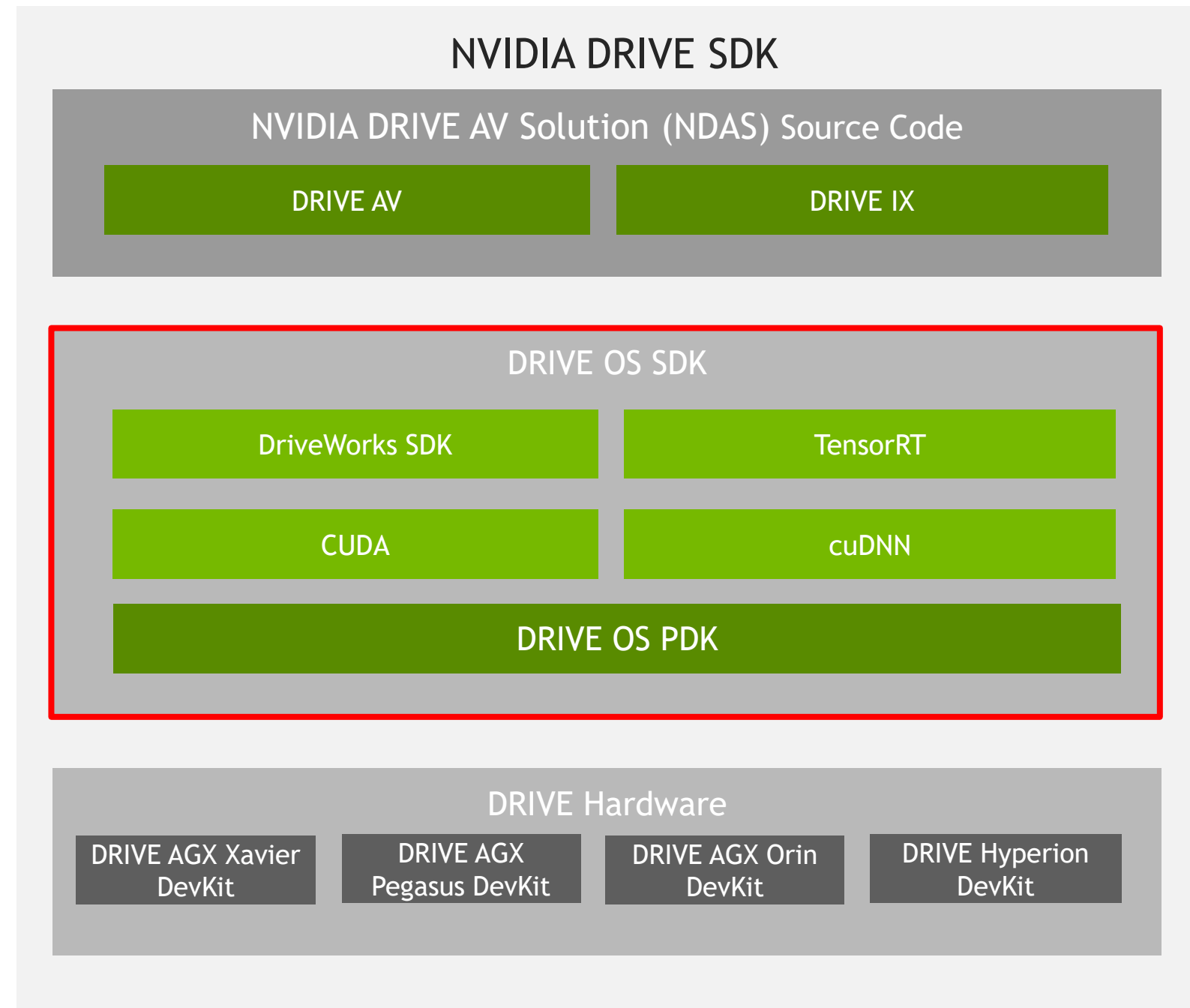
DRIVE SDK

One Architecture | DRIVE OS & DriveWorks | DRIVE AGX Orin



NVIDIA DRIVE SOFTWARE ARCHITECTURE

DRIVE OS



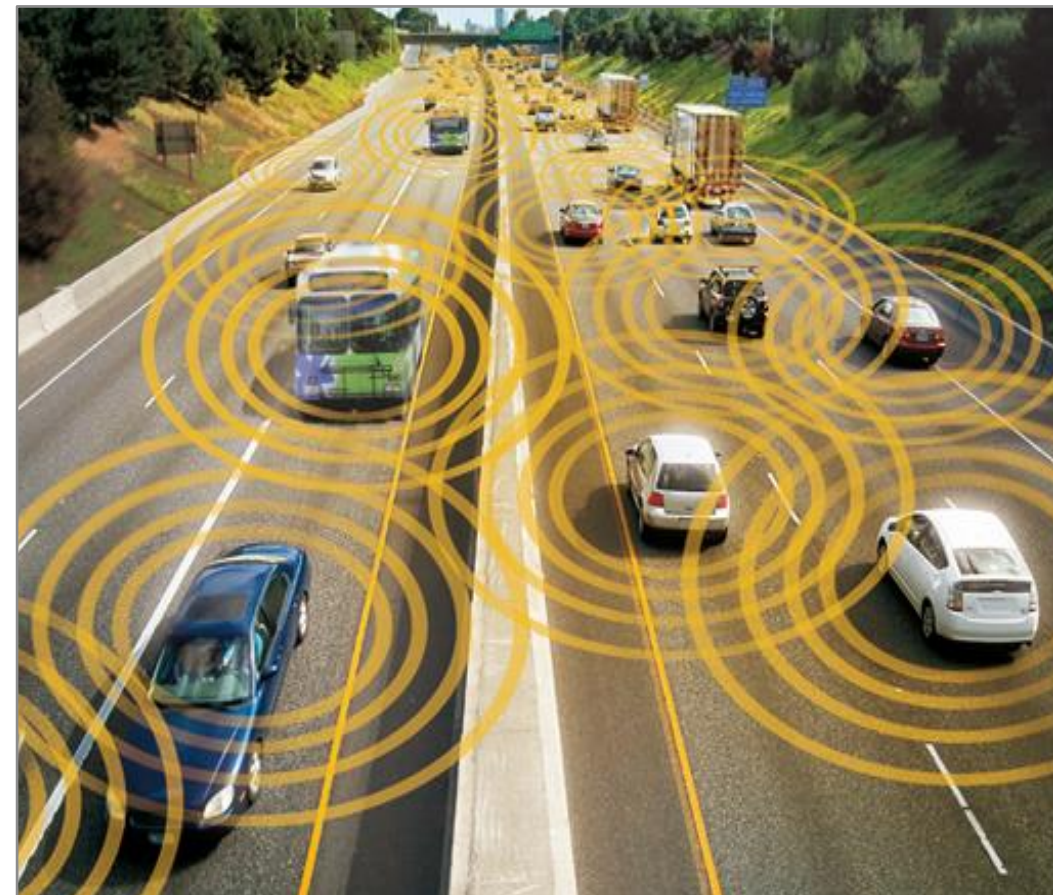
DRIVE OS

For Automated Driving Systems



Safety

Automotive Industry Safety Standards



Scalability

Scalable from L2 to L5

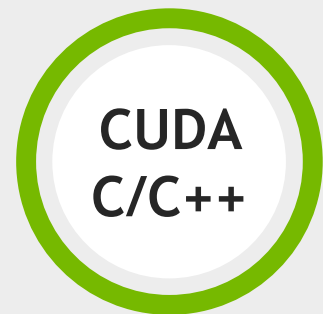


Security

Comprehensive Security Model

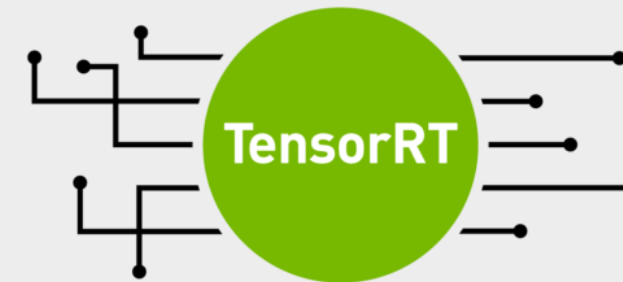
HARDWARE ACCELERATED COMPUTE ENGINES

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

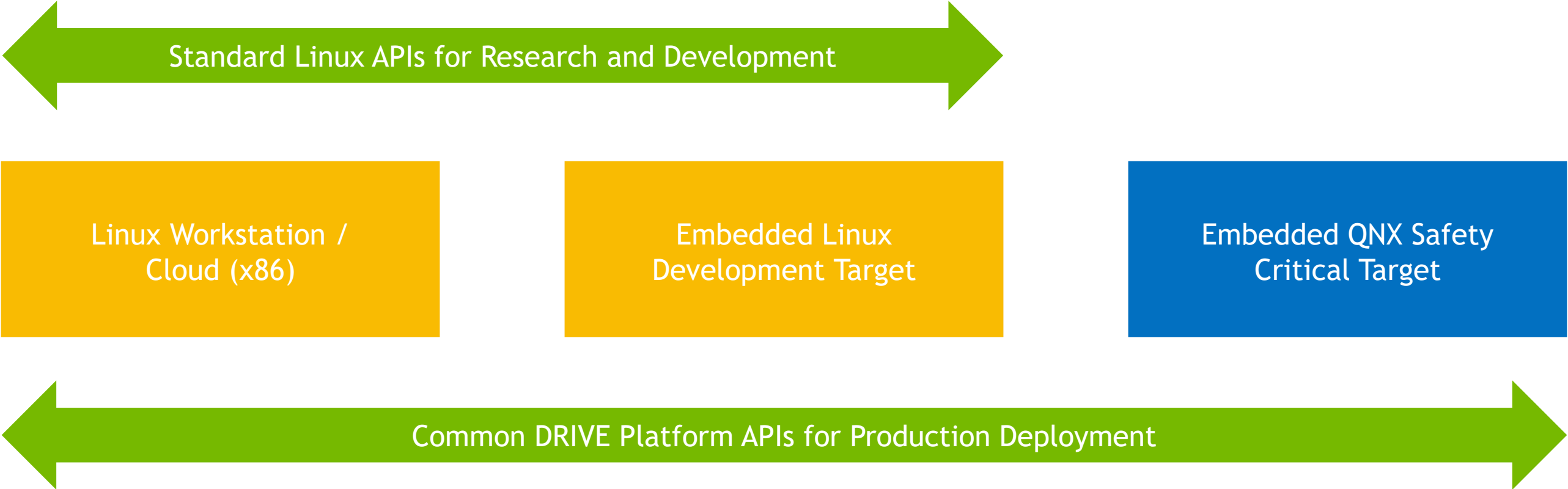


NVSTREAMS

Highly efficient API enabling access to high-speed data transports

DRIVE PLATFORM APIS

Development Strategy



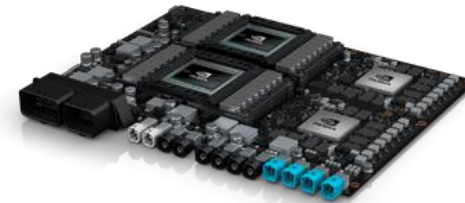
DRIVE DEVELOPER WORKFLOW

Develop on PC | Test on Bench | Deploy to Vehicle | Repeat

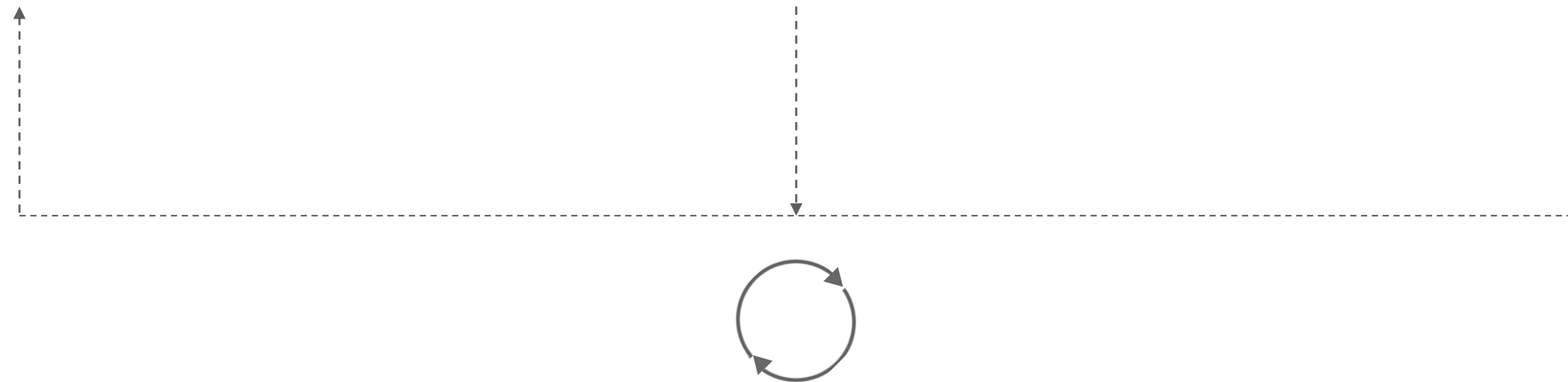
DEVELOP / DEBUG ON PC



DEBUG / PROFILE ON BENCH



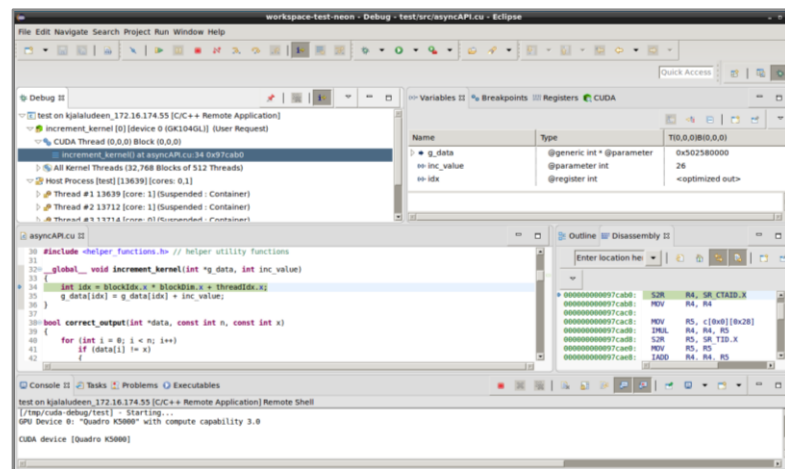
ON ROAD TESTING



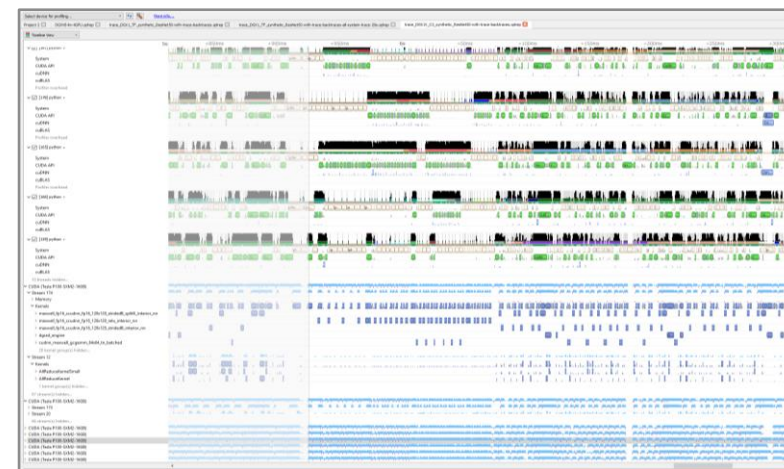
DEPLOY AND CONTINUOUSLY IMPROVE

NSIGHT DEVELOPER TOOLS

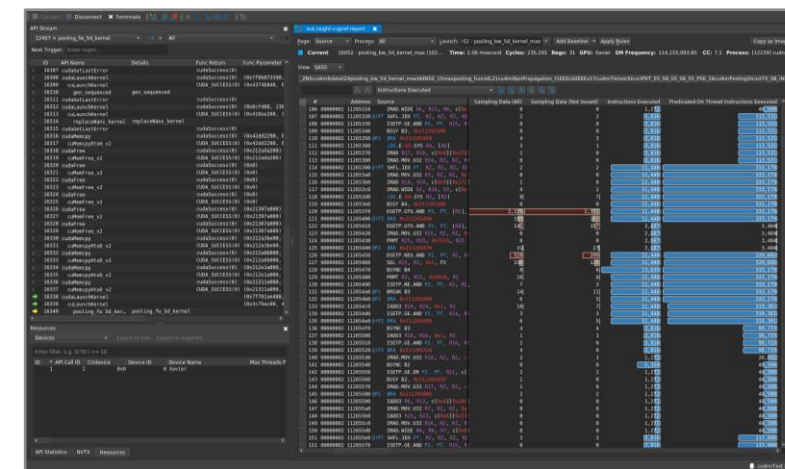
For GPU and CPU Software Debugging and Profiling



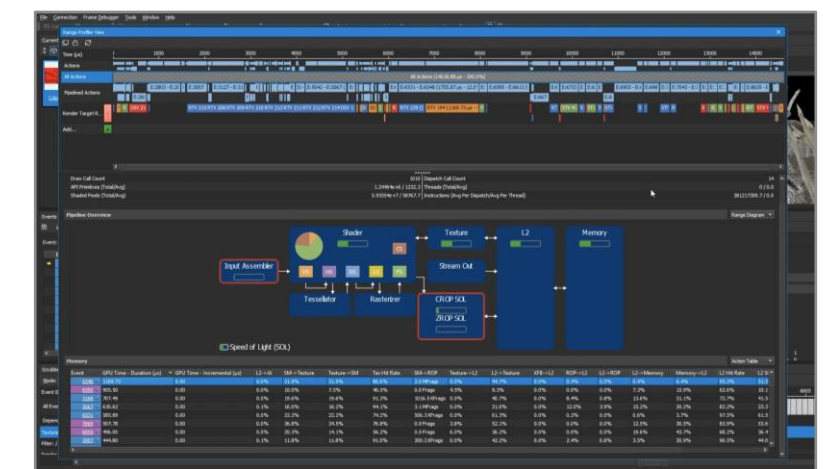
Nsight Eclipse Edition
IDE GPU Application Development



Nsight Systems
System Trace



Nsight Compute
Compute Profiling



Nsight Graphics
Graphics Debugging & Profiling

Maximized with NVTX source code instrumentation NVIDIA tools extension

DRIVE OS ECOSYSTEM

Just Some of Our Partners

SOFTWARE



HARDWARE AND SENSOR



See <https://www.nvidia.com/en-us/self-driving-cars/partners/> for full list of NVIDIA DRIVE Partners

WHAT'S NEW IN DRIVE OS 6

General Availability Starting Q1 2022

DRIVE AGX Orin Developer Kit

Containerized Host Development

Target-side Docker Containers (Linux)

Developer Experience Improvements



DRIVE OS VERSIONS

Software Versions — AGX Xavier vs AGX Orin

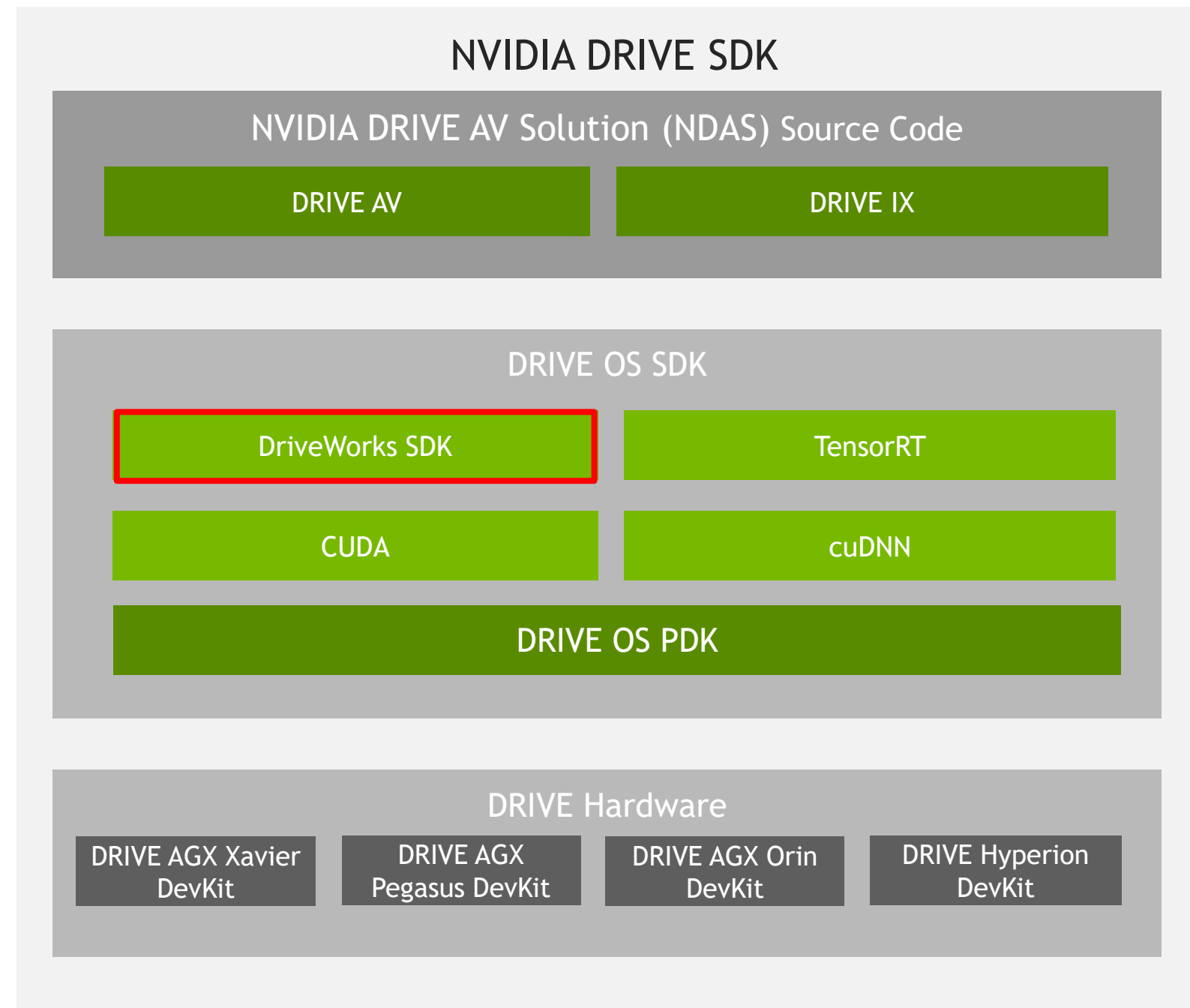
DRIVE Runtime Components	DRIVE OS 5.2 (AGX Xavier)	DRIVE OS 6.0 (AGX Orin)
DriveWorks	3 & 4	5 (Compute graph framework)
Ubuntu Host	18.04	20.04
C++ Feature Set	14	14 & 17
GCC Toolchain (Linux)	5.4	9.3
QCC Toolchain (QNX)	5.3	8.3
Linux Kernel	4.14	5.10
QNX SDP	7.0.4	7.1.1
QNX Microkernel	2.1	2.2
CUDA	10.2	11.4
TensorRT	6.4	8.x
cuDNN	7.6	8.x
Docker Support	Yes (Beta)	Yes



DRIVEWORKS

NVIDIA DRIVE SOFTWARE ARCHITECTURE

DriveWorks



DRIVEWORKS

Middleware for AV Software Development on DRIVE AGX ORIN



SOFTWARE MODULES

Open, modularized library of functions | optimized for DRIVE AGX | easy to integrate and build upon



TOOLS

Software dev tools ranging from sensor data capture to calibration and visualization



DEVELOPER SUPPORT

Sample apps | documentation, tutorials | active developer forum and community



PRODUCTION GRADE

Architected for automotive safety | compliant with industry standards, (ISO 26262/21448, ASPICE, MISRA, CERT)

DRIVEWORKS ARCHITECTURE GOALS

Achieve the Full Throughput of
NVIDIA DRIVE AGX ORIN

Careful architecture of the end-to-end software pipeline

Efficiently utilize numerous hardware engines inside the
DRIVE AGX Orin platform

Optimize data communication formats between engines

Minimize data copies (zero copy exchange of buffers)

Implement and utilize the most efficient algorithms



WHAT'S NEW IN DRIVEWORKS 5

General Availability Starting Q1 2022

Compute Graph Framework

System Task Manager

Image Processing using Orin's GPU, PVA, and OFA engines

Hyperion 8 Sensor Support

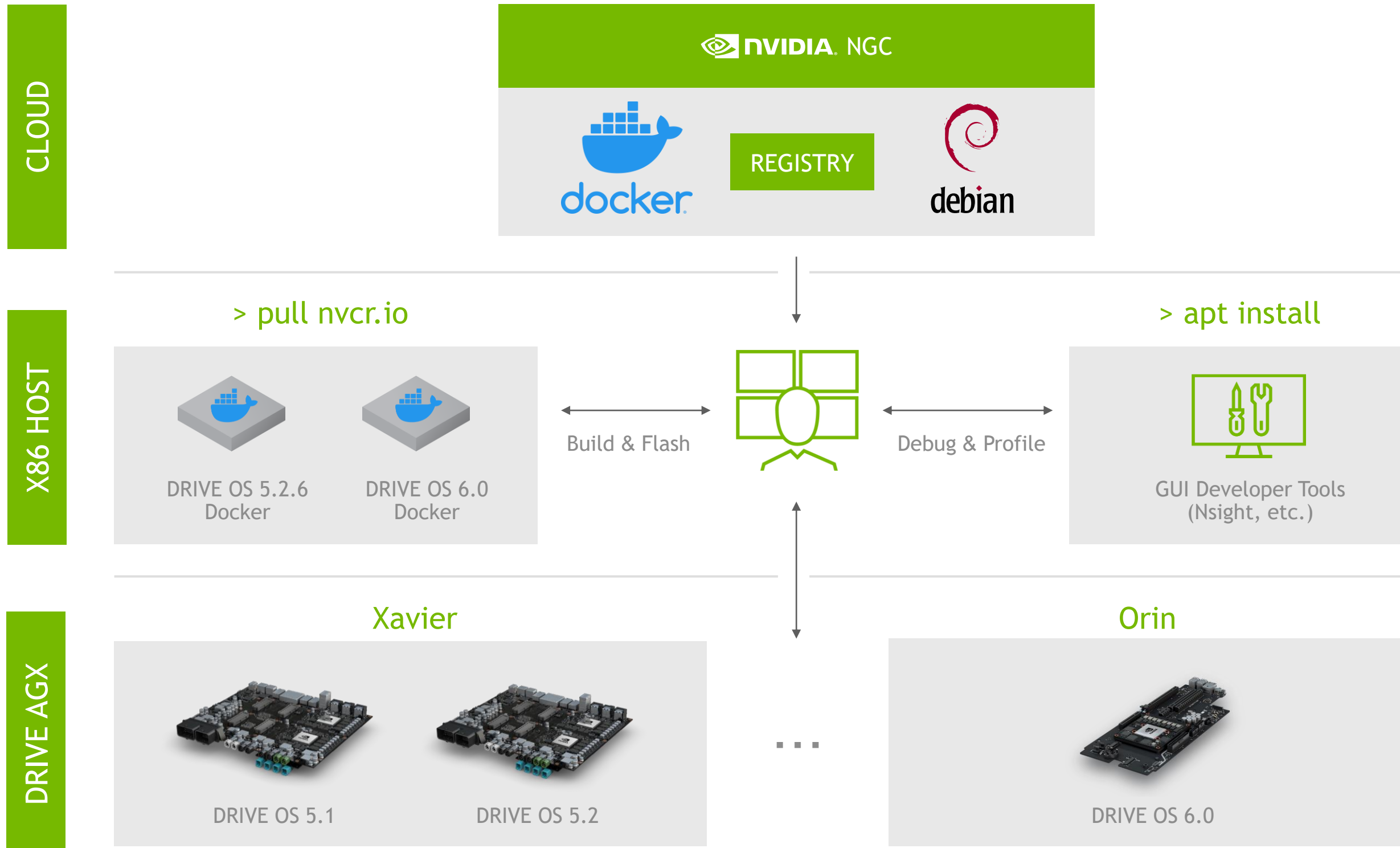




NEW DEVELOPMENT PARADIGM

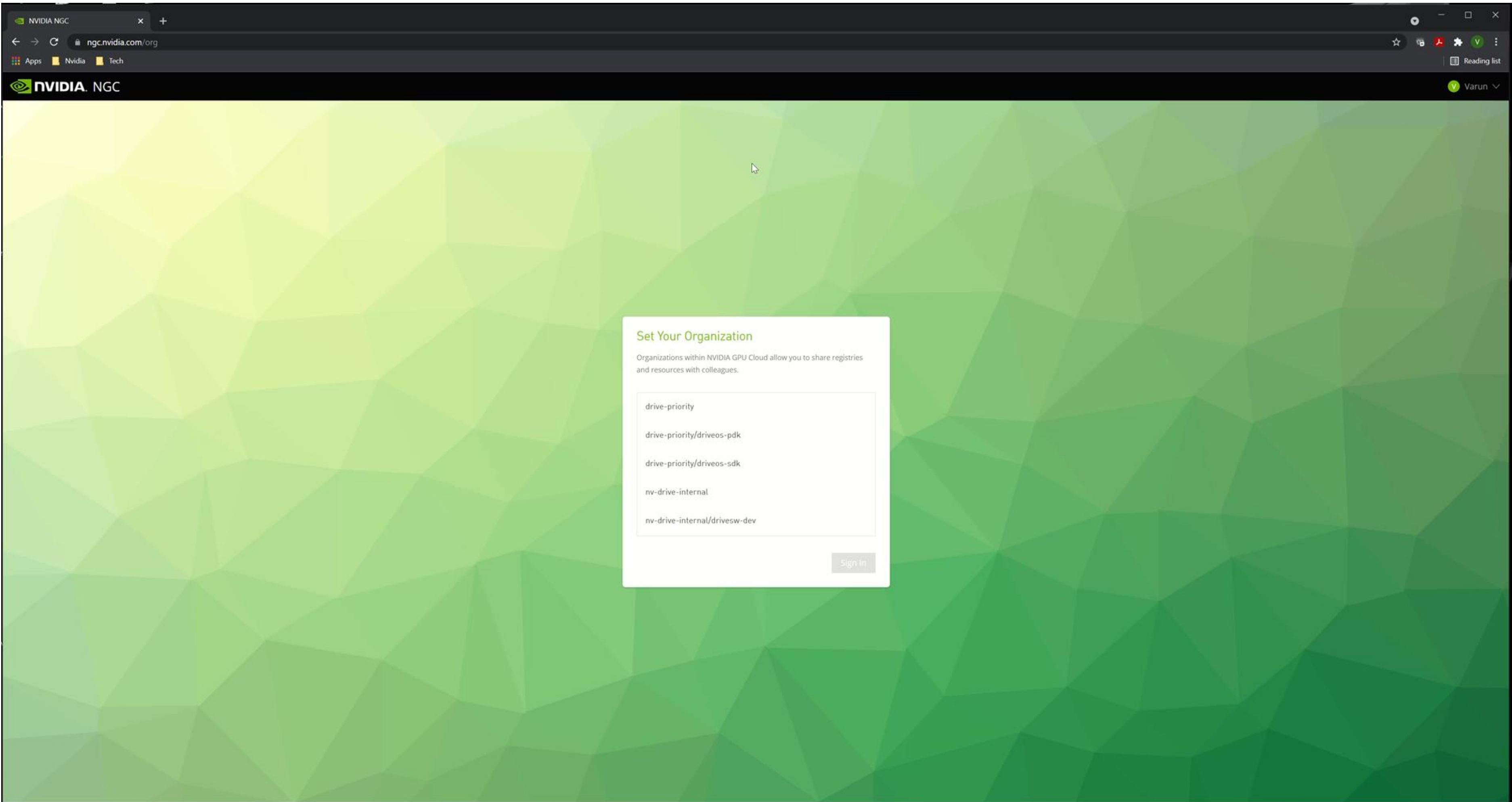
DRIVE PLATFORM DOCKER CONTAINERS

Host Independence | Encapsulation | Homogenous Build





DEMO



```
varunt@varunt-linux: ~  
4b229c5cd63a: Pull complete  
87f298cc5caa: Pull complete  
4fba2653fe55: Pull complete  
6641666b02e9: Pull complete  
9c6a478eb7d0: Pull complete  
dd54df26b1ff: Pull complete  
a9ef312a75fe: Pull complete  
bdcdb16f0654: Pull complete  
1dee5ac63a68: Pull complete  
6aaf249ef4f7: Pull complete  
4dd872b84665: Pull complete  
4c8f073ec657: Pull complete  
e4d0c3682b9f: Pull complete  
2ab2120d177d: Pull complete  
b01df36450d3: Pull complete  
c6ee2355b539: Pull complete  
644fedda9058: Pull complete  
87ab866758ce: Pull complete  
ab369421c2cb: Pull complete  
8796ceff4b90: Pull complete  
3b4d5f706c79: Pull complete  
3a4fc9e34472: Pull complete  
977a8ef55793: Pull complete  
28d6f002b232: Pull complete  
77f0b51c9127: Pull complete  
5ef3e31aa08a: Pull complete  
0050d17e9a9d: Pull complete  
aafa20c3a0e4: Pull complete  
32b6d9660411: Pull complete  
54d3b5693929: Pull complete  
ec7a1fa8c926: Pull complete  
5de96b449693: Pull complete  
4884ee3f70eb: Pull complete  
19a2f4192336: Pull complete  
9ebcf2125e76: Pull complete  
99e6586856a0: Pull complete  
6bc796ab3e2d: Pull complete  
e65d6b5a5746: Pull complete  
df7d6fcea023: Pull complete  
1f079428cd70: Pull complete  
27c19a41e831: Pull complete  
399ac86c2e25: Pull complete  
Digest: sha256:f3adcb9247d0617719dabb687cca80b56ec1ea16c8d386c6c66f29c1d3afa255  
Status: Downloaded newer image for nvcr.io/drive-priority/driveos-sdk/drive-agx-orin-linux-aarch64-sdk-build-x86:6.0.0.1-0001  
nvcr.io/drive-priority/driveos-sdk/drive-agx-orin-linux-aarch64-sdk-build-x86:6.0.0.1-0001  
varunt@varunt-linux:~$  
varunt@varunt-linux:~$
```

root@varunt-linux:/drive#

DRIVE SDK PARTNERS

V O L V O



veoneer

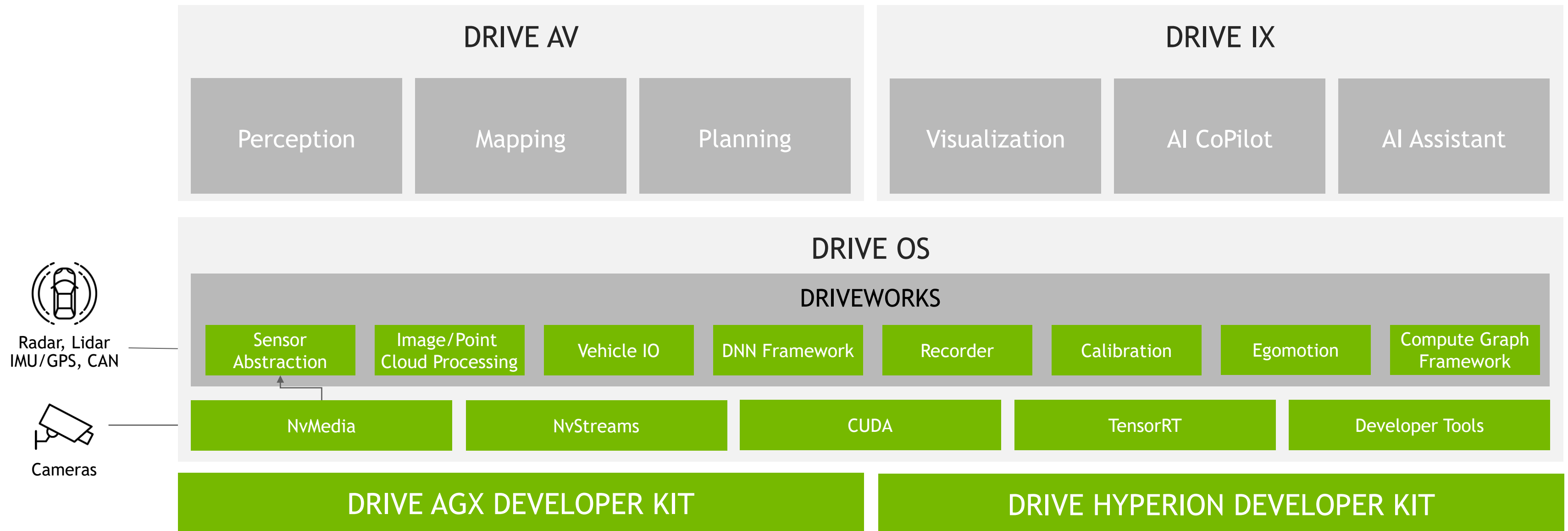




SUMMARY

NVIDIA DRIVE SOFTWARE ARCHITECTURE

Open and Modular Software for AV Development



GET STARTED WITH DRIVE SDK

Extensive Documentation & Training Material Available on DRIVE Developer Site

LEARN MORE

Visit the DRIVE training page for upcoming / past webinars and other resources (<https://developer.nvidia.com/drive/training>)
Check out all information related to DRIVE AGX and DRIVE SDK (<https://developer.nvidia.com/drive>)

GET ACCESS

Join the NVIDIA DRIVE developer program for DRIVE AGX (<https://developer.nvidia.com/drive-agx-program>)
Read DRIVE OS and DriveWorks documentation (<https://docs.nvidia.com/drive>)
Download latest DRIVE SDK includes DRIVE OS and DriveWorks (<https://developer.nvidia.com/drive/downloads>)
Contact NVIDIA automotive team (<https://www.nvidia.com/en-us/self-driving-cars/self-driving-cars-contact-us/>)

DEVELOP AND TEST

Use the DRIVE OS and DriveWorks numerous sample applications as a starting point for development

SHARE YOUR WORK

Get your work featured on the NVIDIA DRIVE partner page (<https://www.nvidia.com/en-us/self-driving-cars/partners/>)
Browse and connect on the DRIVE AGX forum (<https://forums.developer.nvidia.com/c/agx-autonomous-machines/drive-agx/>)

