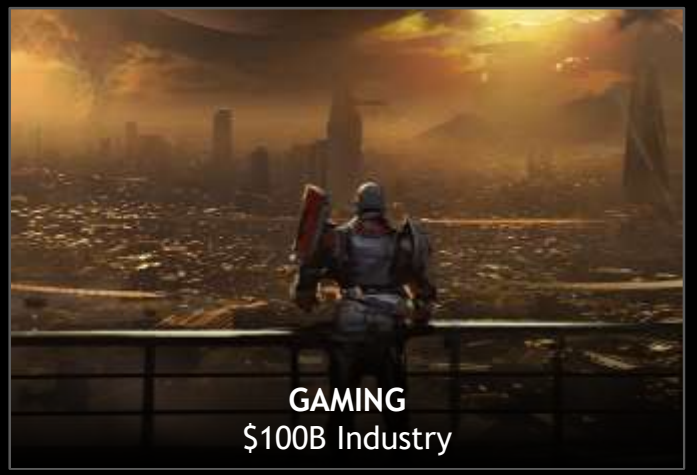
END TO END NEEDS FOR AUTONOMOUS VEHICLES

NORM MARKS |SEPT. 6, 2018

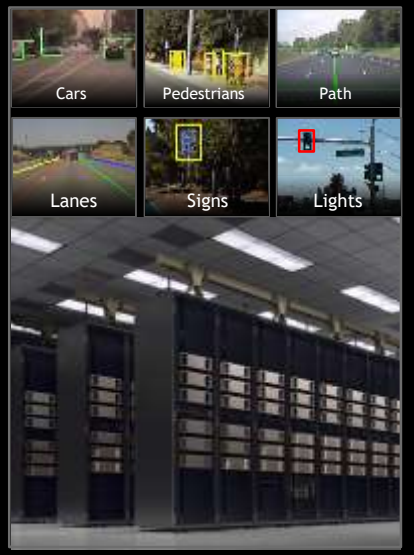
THE MOST EXCITING TIME IN TECH HISTORY



NVIDIA GPU

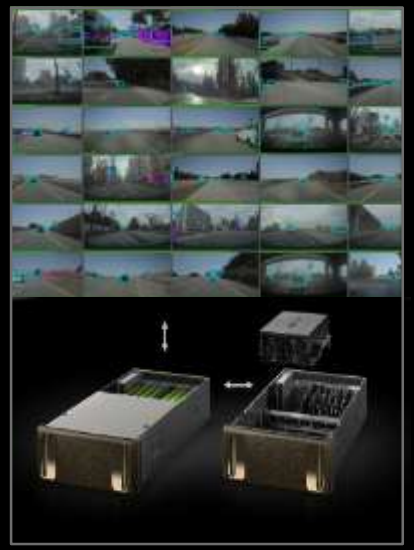
END-TO-END SYSTEM FOR AV

COLLECT DATA

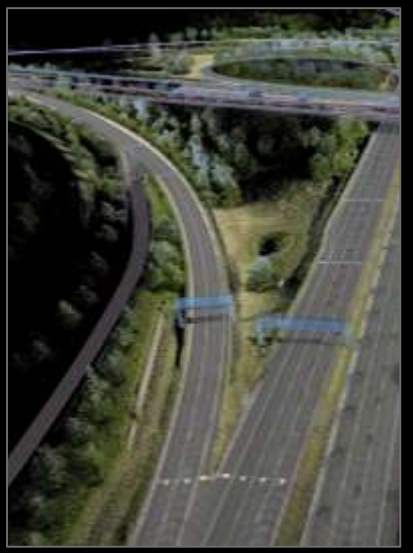


TRAIN MODELS

SIMULATE



RE-SIMULATE



MAPPING

Sources: NVIDIA & RAND Corporation

NVIDIA

NVIDIA PERCEPTION INFRASTRUCTURE

LARGE-SCALE DEEP LEARNING MODEL DEVELOPMENT

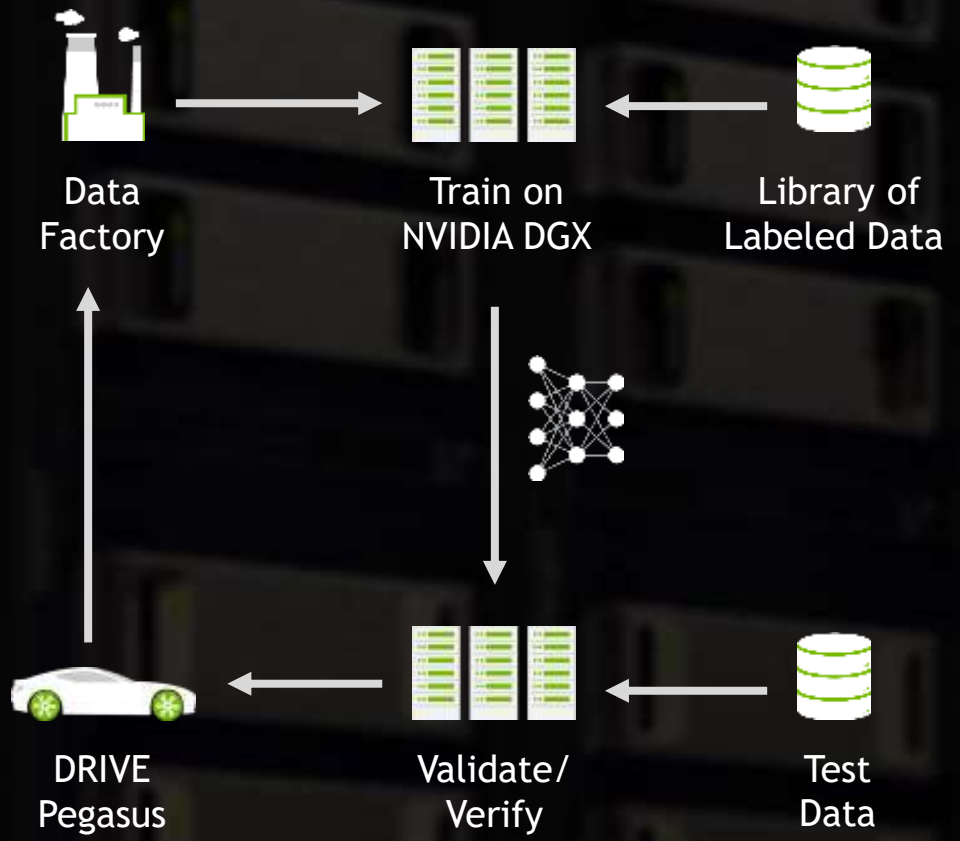
Workflow, Tools, Supercomputing Infrastructure

Data Ingest, Labeling, Training, Validation, Adaptation

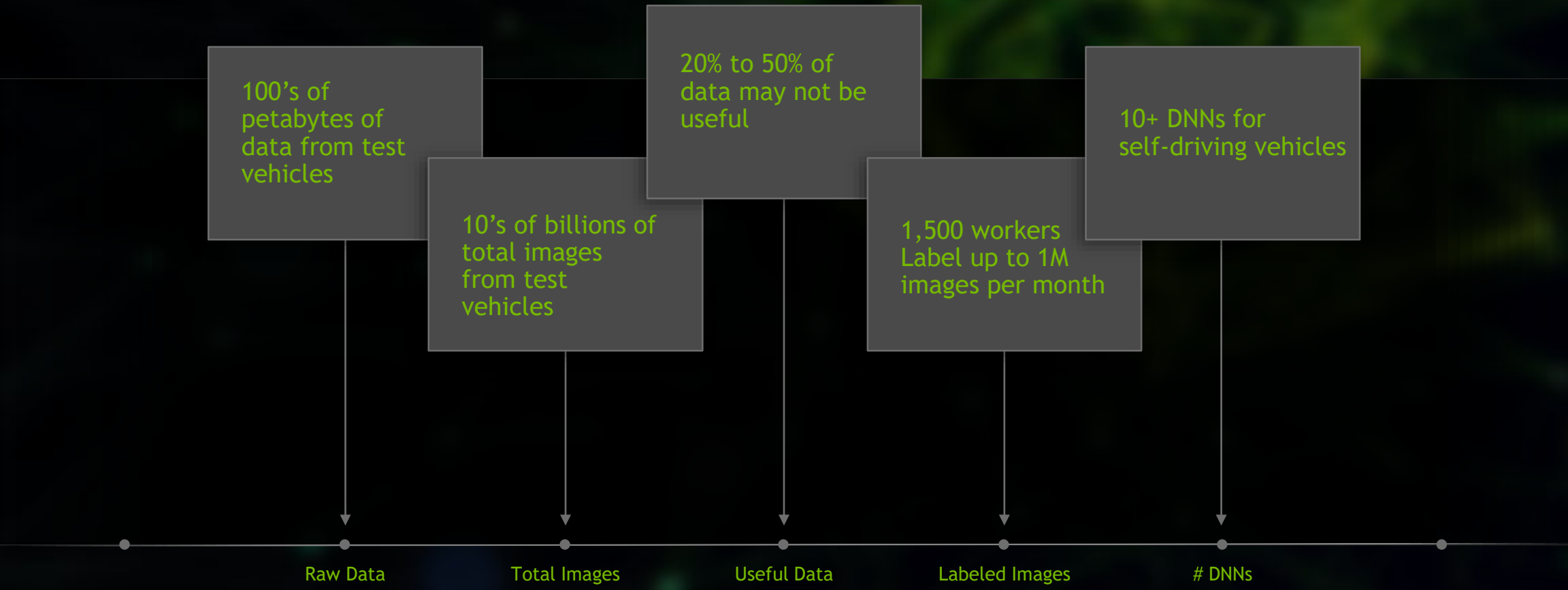
Automation, Best Model Discovery, Traceability, Reproducibility

Purpose-built for Safety Standards of Automotive

"Data is the new source code"

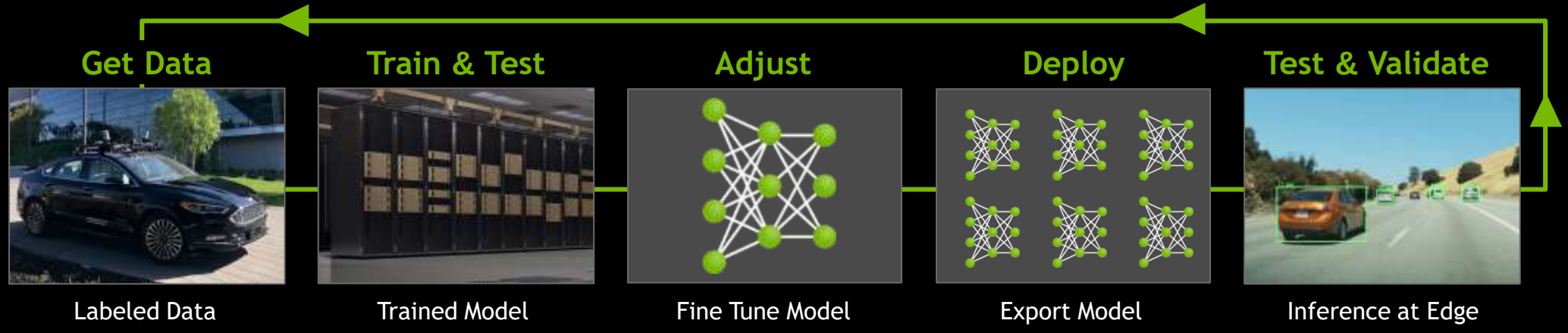


DATA COLLECTION AND LABELING FOR AI



Source: Data from test fleets of 50-100 cars

AI FOR SELF-DRIVING WORKFLOW



DNN Development
Exploration
Development
Model Selection

Simulate

Re-Simulate

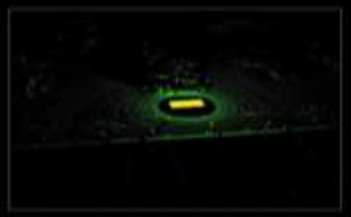
AI FOR SELF-DRIVING


Perception


Free Space Perception


Distance Perception


Weather


LIDAR Perception


Camera-based Mapping

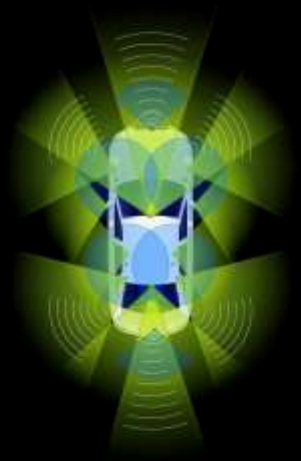

Camera Localization to HD Map


LIDAR Localization to HD Map


Path Perception


Scene Perception

AI OUTSIDE AND INSIDE THE VEHICLE



Exterior Driver Recognition

Automatic Personalization

Device usage detection

Cyclist Alert

Distracted Driver Alert

Driver/Passenger Recognition

Customer Application

DRIVE AV
Object, Freespace, Path / Lane, Path Planning, Wait, Map, Sign, Lights, Road Markings, Surround

DRIVE IX
Gaze, Eye Openness, Head Pose, Gestures, Emotions
Facial Recognition, Voice Recognition & Lip Reading

DRIVE OS

MANY THINGS TO LEARN

“ Autonomous vehicles need to be driven more than 11 billion miles to be 20% better than humans. With a fleet of 100 vehicles, 24 hours a day, 365 days a year, at 25 miles per hour, this would take 518 years.”

Rand Corporation, Driving to Safety

SIMULATION
THE PATH TO BILLIONS OF MILES

World drives trillions of miles each year.

U.S. has 770 accidents per billion miles.

A fleet of 20 test cars cover 1 million miles per year.

NVIDIA DRIVE SIM AND CONSTELLATION

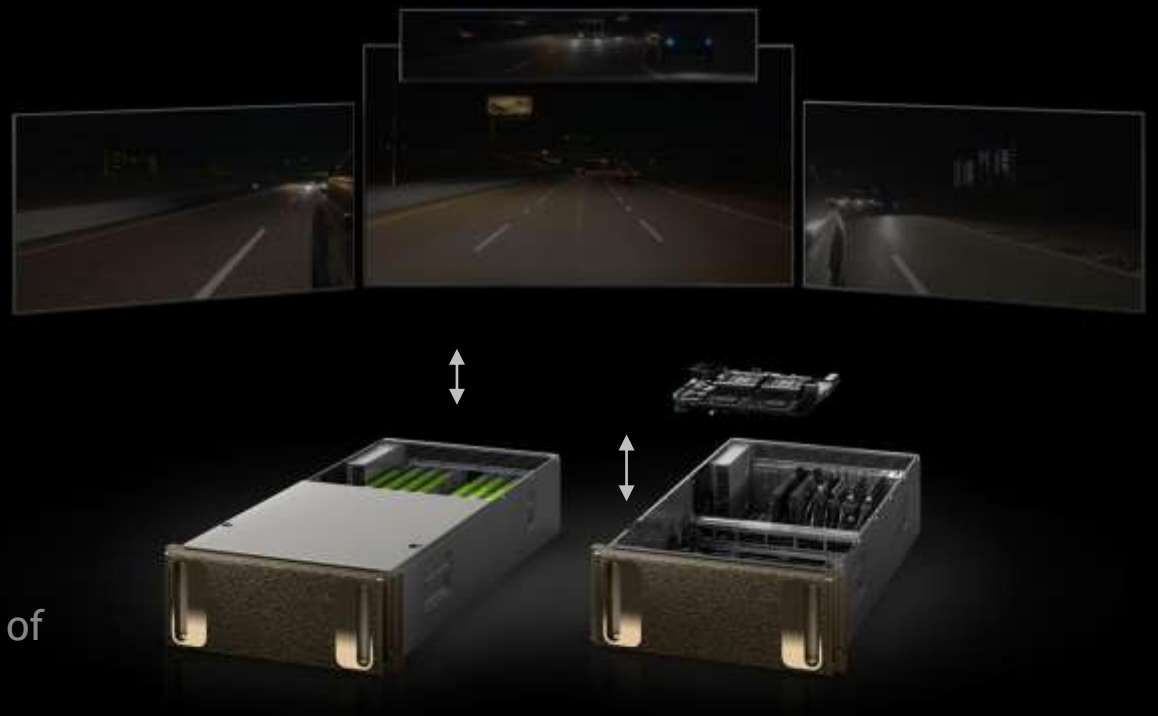
AV VALIDATION SYSTEM

- Virtual Reality AV Simulator
- Same Architecture as DRIVE Computer
- Simulate Rare and Difficult Conditions, Recreate Scenarios, Run Regression Tests, Drive Billions of Virtual Miles
- 1,000’s Constellations Drive Billions of Miles per Year

NVIDIA DRIVE SIM AND CONSTELLATION

AV VALIDATION SYSTEM

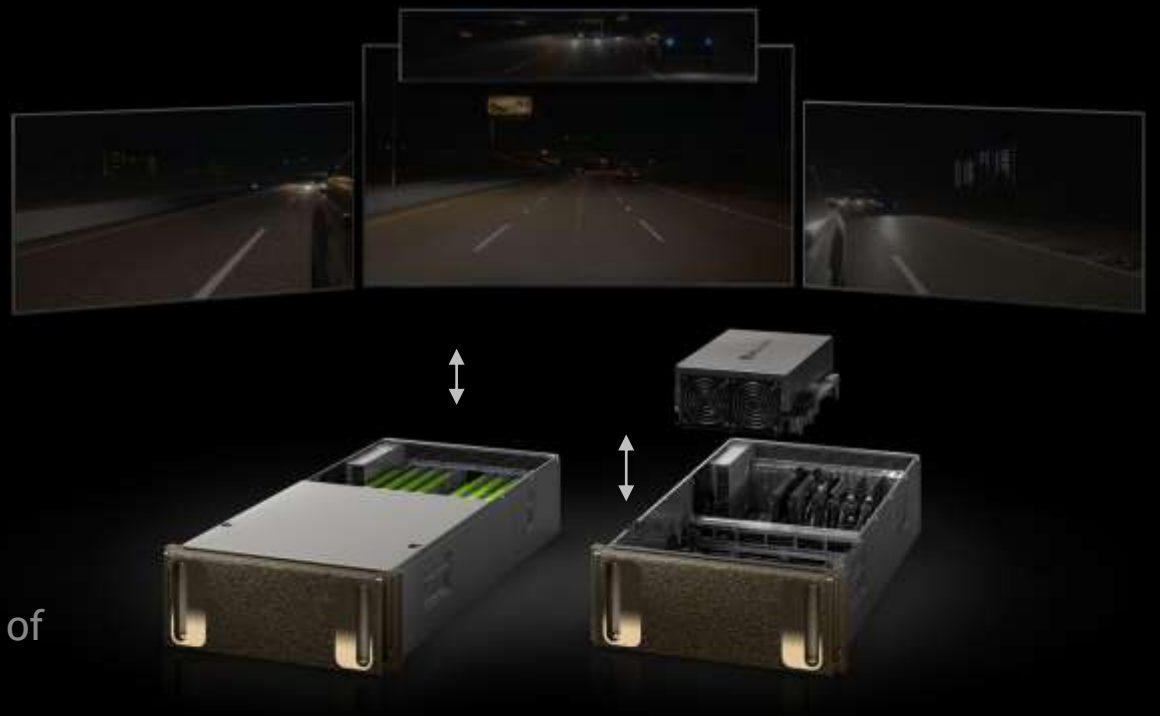
- Virtual Reality AV Simulator
- Same Architecture as DRIVE Computer
- Simulate Rare and Difficult Conditions, Recreate Scenarios, Run Regression Tests, Drive Billions of Virtual Miles
- 1,000’s Constellations Drive Billions of Miles per Year



NVIDIA DRIVE SIM AND CONSTELLATION

AV VALIDATION SYSTEM

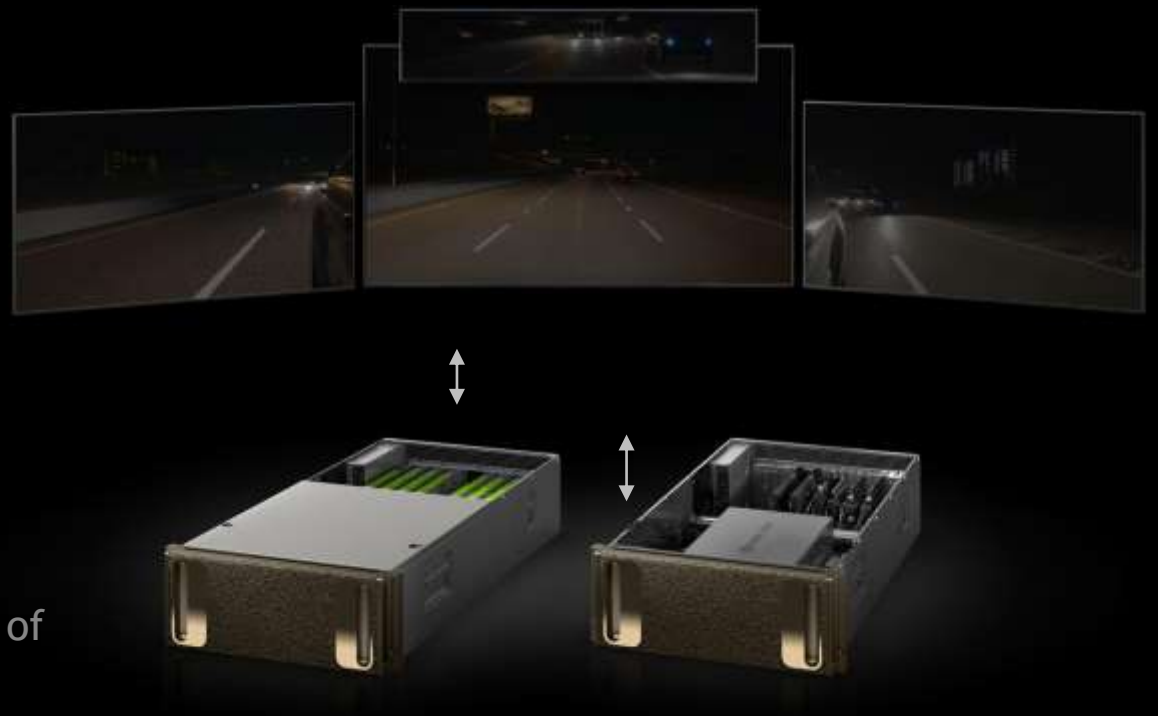
- Virtual Reality AV Simulator
- Same Architecture as DRIVE Computer
- Simulate Rare and Difficult Conditions, Recreate Scenarios, Run Regression Tests, Drive Billions of Virtual Miles
- 1,000’s Constellations Drive Billions of Miles per Year



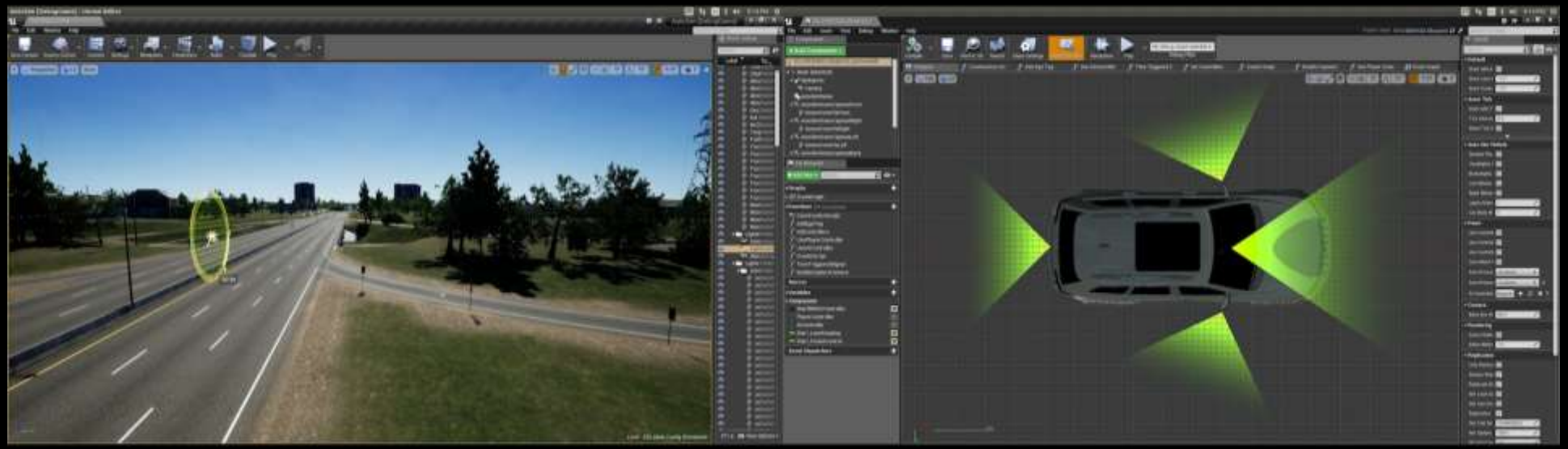
NVIDIA DRIVE SIM AND CONSTELLATION

AV VALIDATION SYSTEM

- Virtual Reality AV Simulator
- Same Architecture as DRIVE Computer
- Simulate Rare and Difficult Conditions, Recreate Scenarios, Run Regression Tests, Drive Billions of Virtual Miles
- 1,000’s Constellations Drive Billions of Miles per Year



MULTI-SENSOR SIMULATION

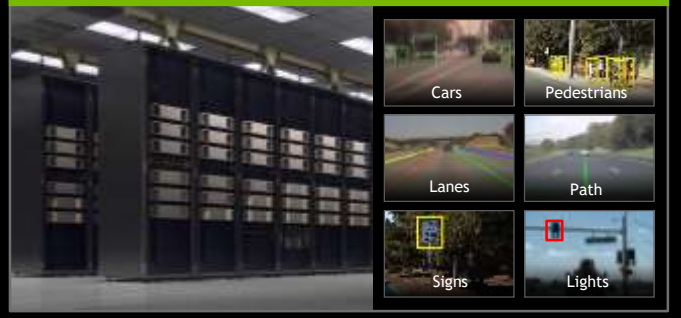


Setting Up The Environment

NVIDIA DRIVE END-TO-END PLATFORM

COLLECT & PROCESS DATA

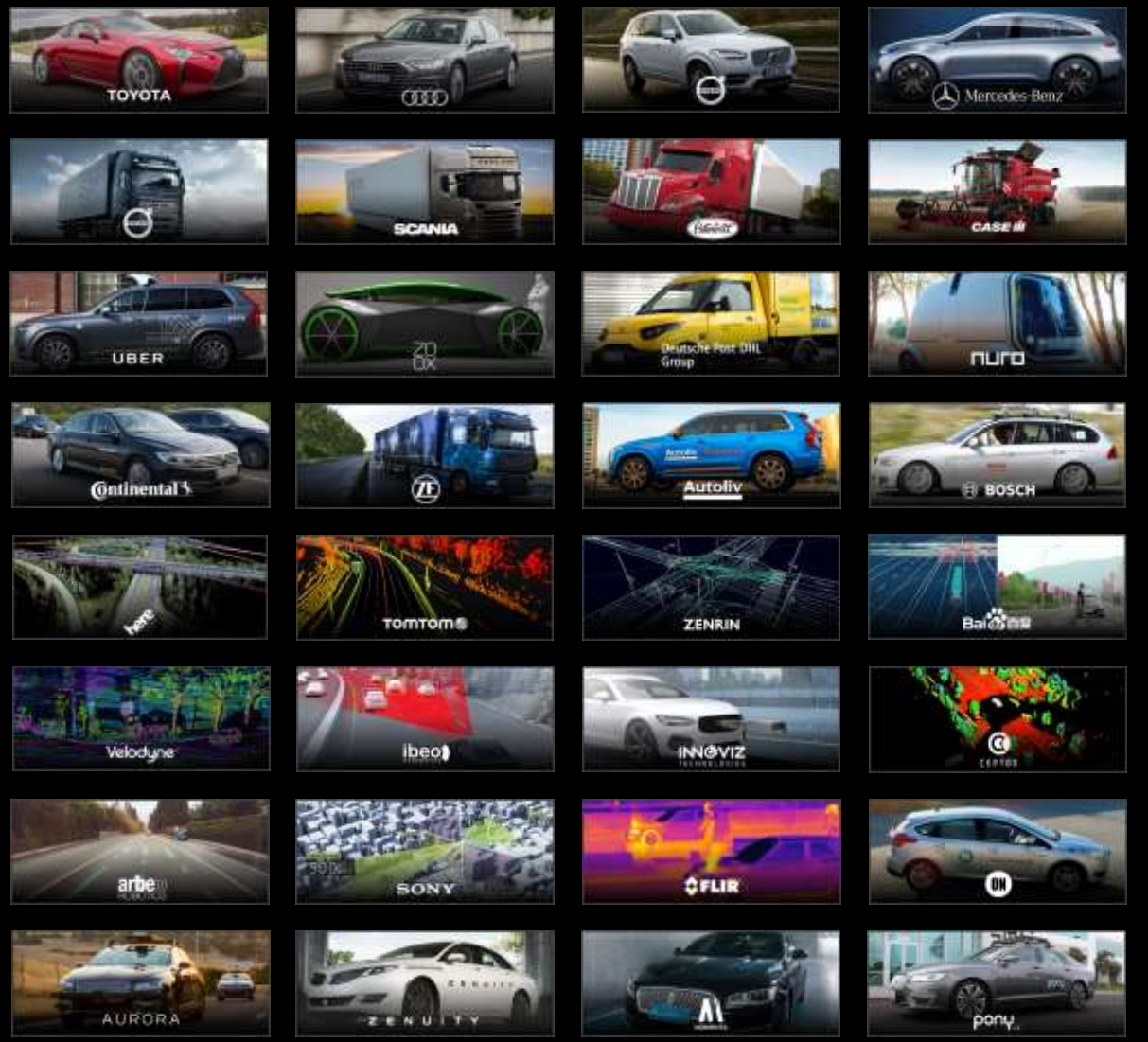
TRAIN MODELS



SIMULATE

DRIVE

370 PARTNERS DEVELOPING ON NVIDIA DRIVE



CARS

TRUCKS

MOBILITY SERVICES

SUPPLIERS

MAPPING

LIDAR

CAMERA / RADAR

STARTUPS

NVIDIA

KEY TAKEAWAYS

1. Understand end-to-end requirements of autonomous vehicle development
2. AI demands data center design built on dense GPU compute-at-scale
3. Consider the complete workflow of AI from experimentation to training to inference
4. Carefully weigh cost of productivity vs hardware cost alone = true TCO of DL
5. NVIDIA best practices leads to TSTADI reference platform
   (Training, Simulation, Testing for Autonomous Driving Infrastructure)

THANK YOU

NORM MARKS | NMARKS@NVIDIA.COM