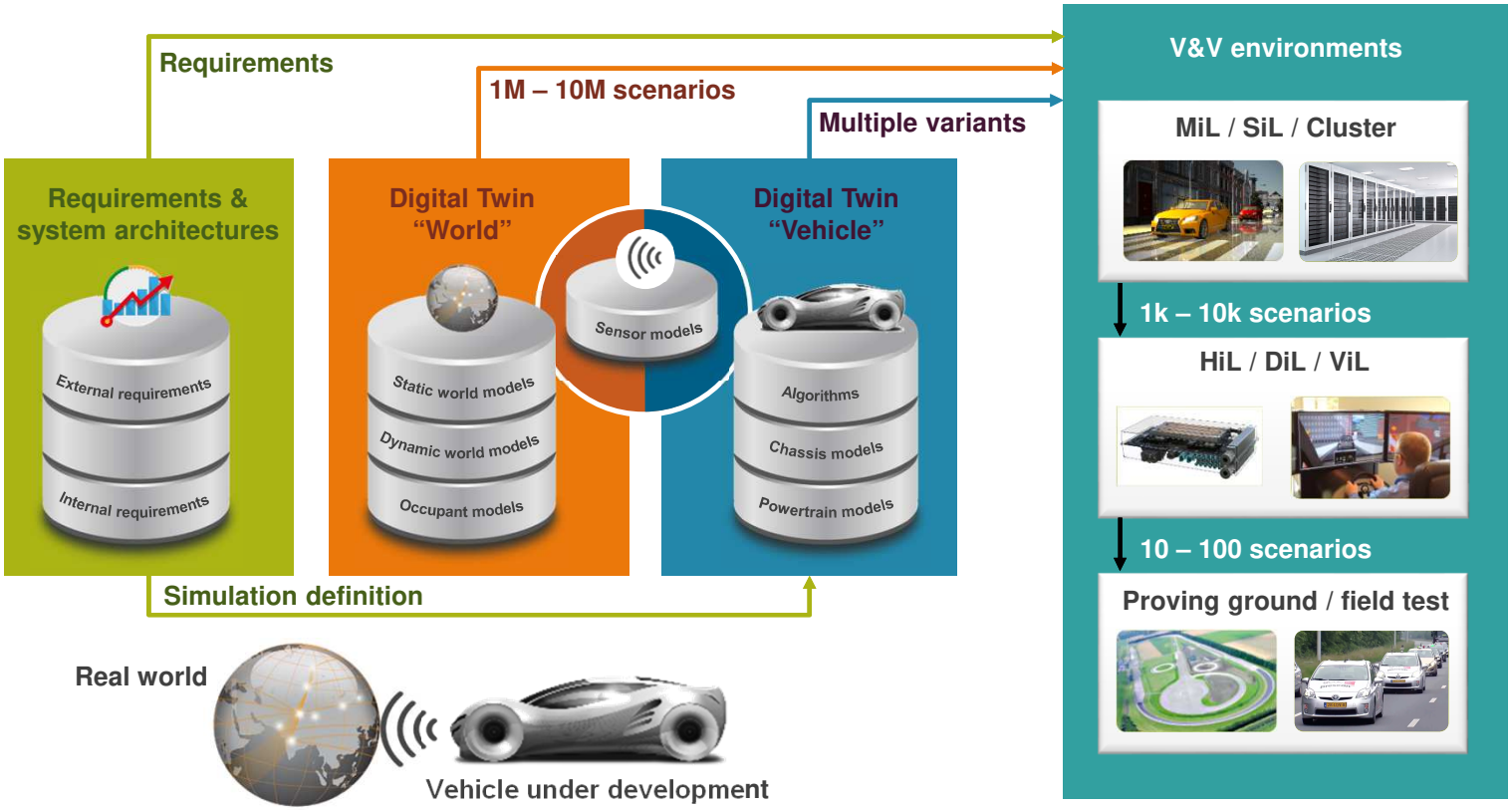
SIEMENS
Ingenuity for life

Physics Based Sensor simulation

Jordan Gorrochotegui - Product Manager
Mike Phillips – Software Engineer

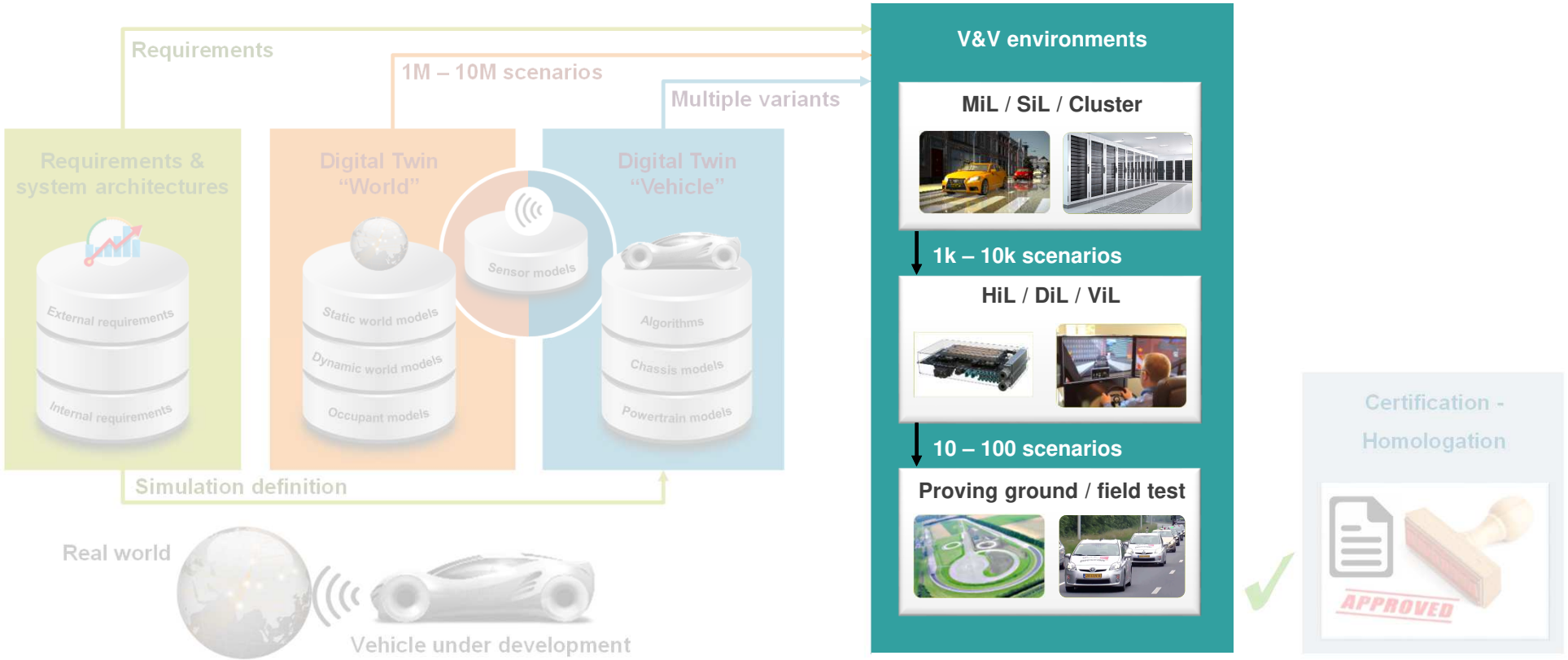
Validation and Verification framework for AVs

SIEMENS
Ingenuity for life



Validation and Verification framework for AVs

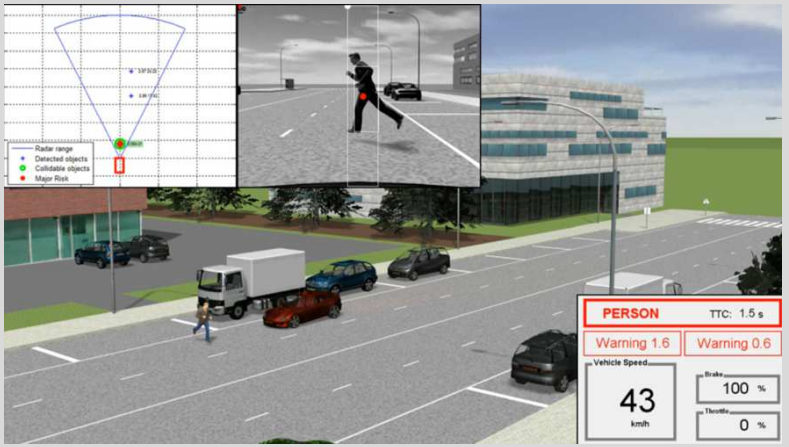
SIEMENS
Ingenuity for life



Example #1: MiL / SiL / Cluster

SIEMENS
Ingenuity for life

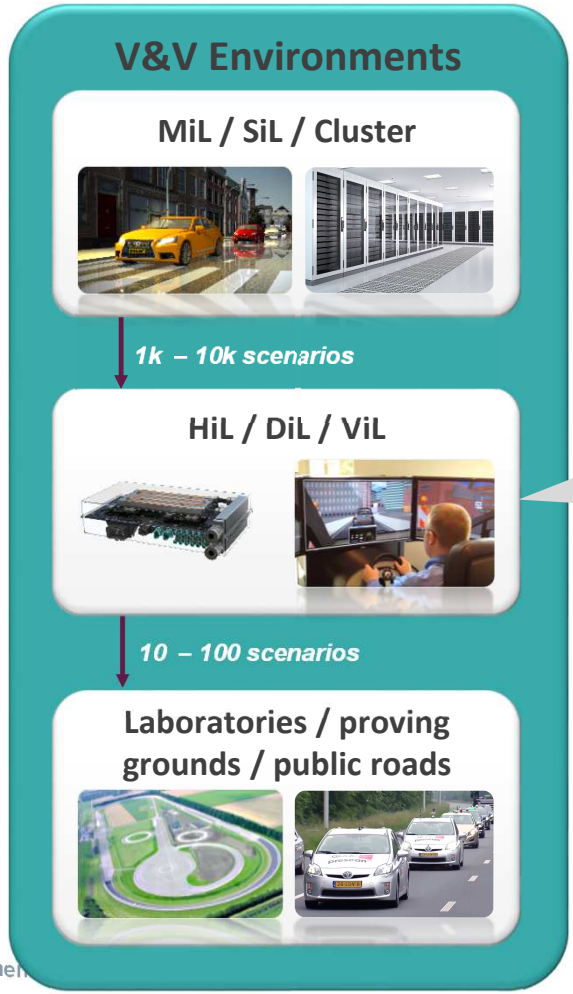
Run massive amounts of Prescan scenarios for Automated Vehicle development and optimization

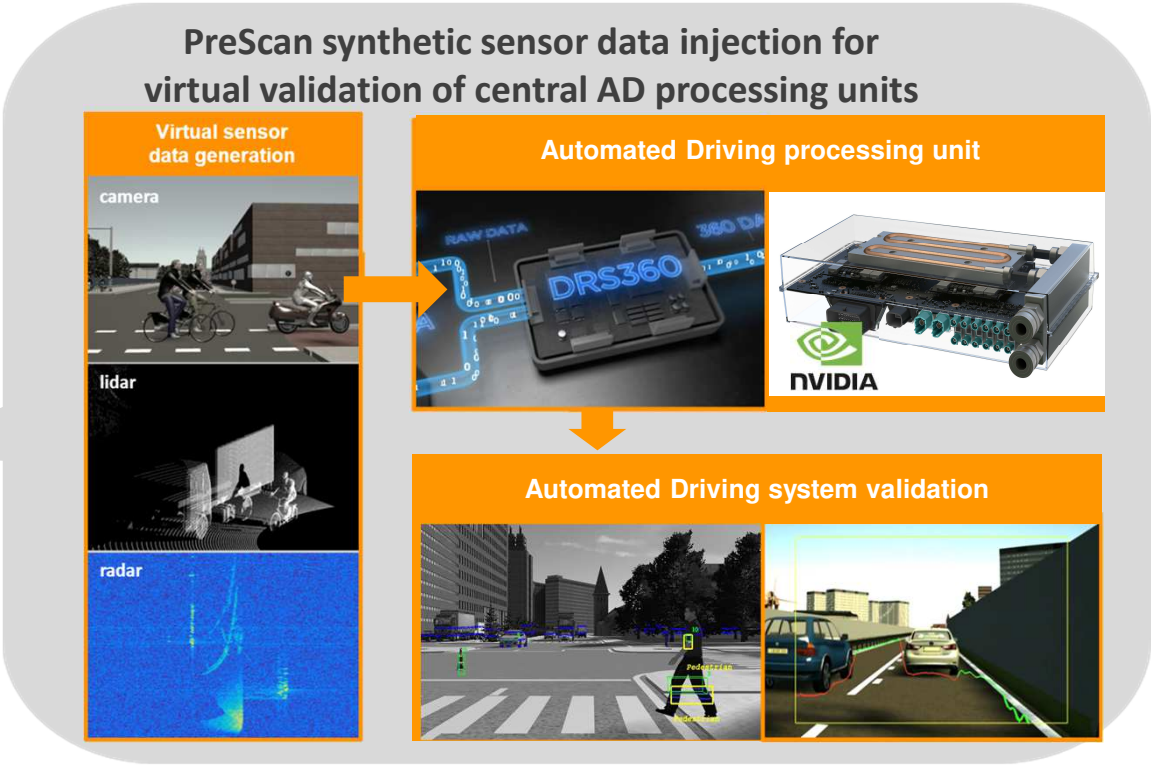


- Design space exploration using large scenario databases
- Virtual development, verification and robustness testing
- Optimized automated vehicle designs
- Training of Deep Neural Networks (DNNs)

Example #2: HiL testing of central AD processing unit

SIEMENS
Ingenuity for life

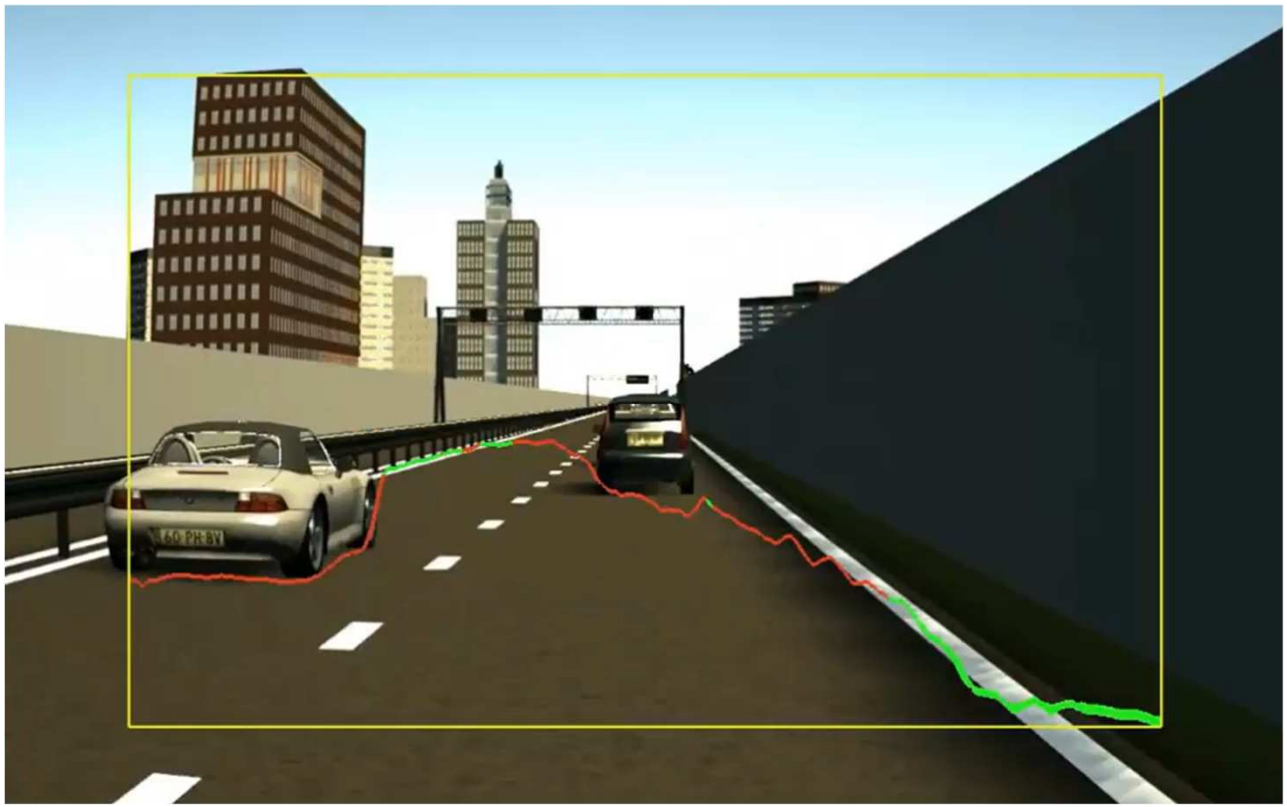




- Evaluation of Deep Neural Networks (DNNs)
- Virtual validation of automated driving processing units
- Accelerated automated vehicle development

Example #2: HiL testing of central AD processing unit

SIEMENS
Ingenuity for life



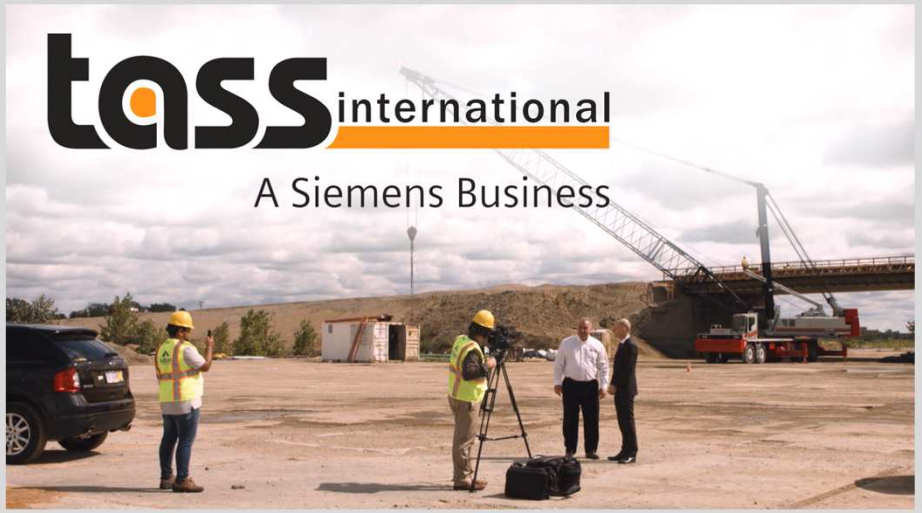
Free space detection on Nvidia Drive PX2

NVIDIA

Example #3: Automated Driving physical validation

SIEMENS
Ingenuity for life

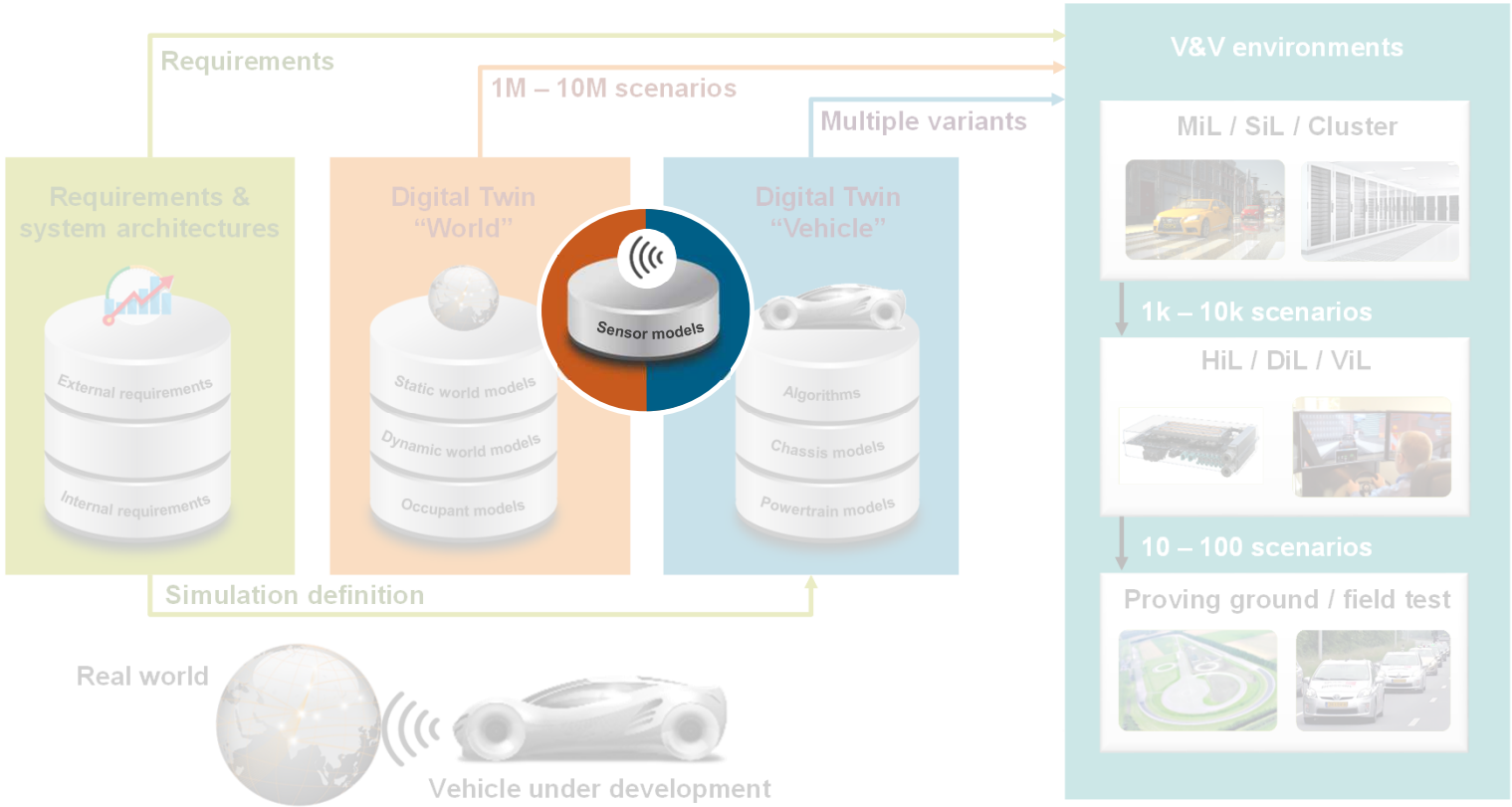
TASS International Services and Siemens Testing Solutions for physical validation of automated and connected driving technology



- Physical verification & validation services
- Certification of automated and connected systems
- Design consultancy for “next-generation” AD test facilities

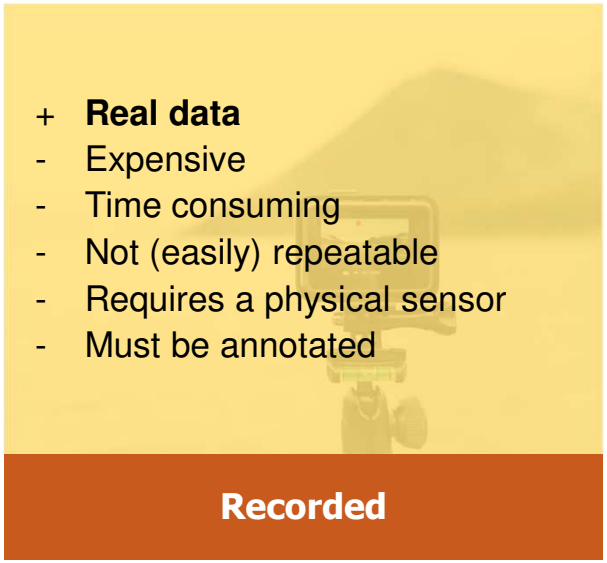
Validation and Verification framework for AVs

SIEMENS
Ingenuity for life



SIEMENS
Ingenuity for life

Two sources of sensor data



+ **Real data**
- Expensive
- Time consuming
- Not (easily) repeatable
- Requires a physical sensor
- Must be annotated

Recorded

? Realistic data
+ **Inexpensive**
+ **Fast to acquire**
+ **Perfect repeatability**
+ **Physical sensor not needed**
+ **Annotation is free**

Simulated

SIEMENS
Ingenuity for life

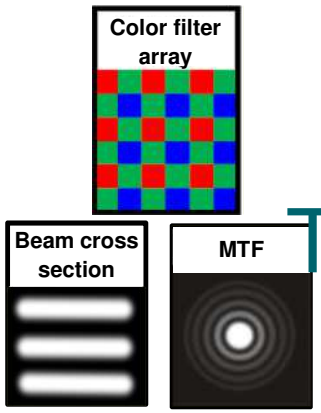
We use simulation to compute real world effects on actual sensors

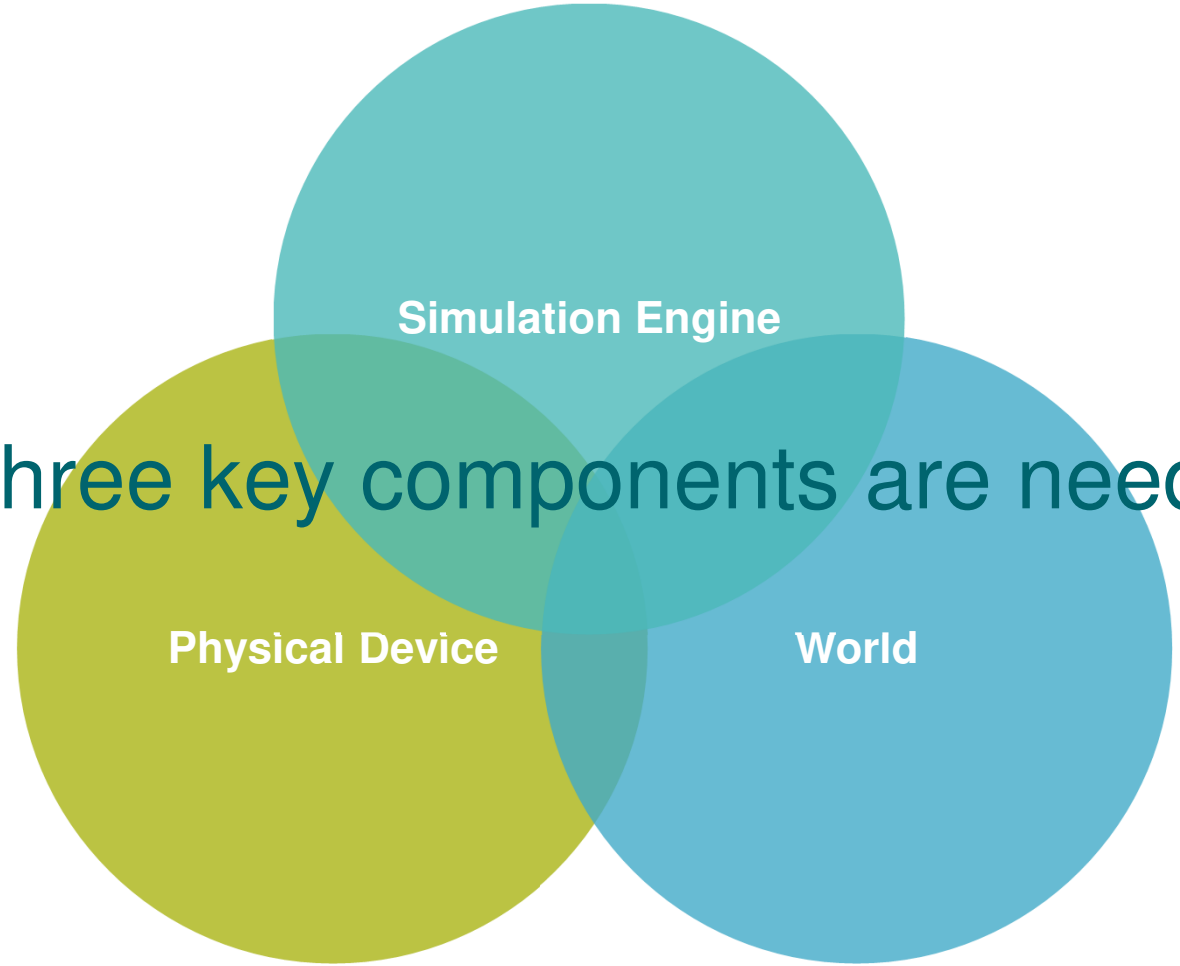
Physical artefacts are faithfully reproduced	Raw signal is computed	Output verified & validated
• Distortions • Multi-bounce • Time effects • Weather • …	• Lidar full-waveform signal • Radar channel response • Raw camera images • …	• Verify against real sensors • Validate for specific use cases

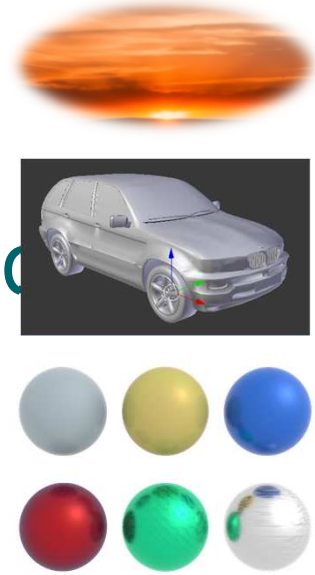
prescan

SIEMENS
Ingenuity for life

Three key components are needed

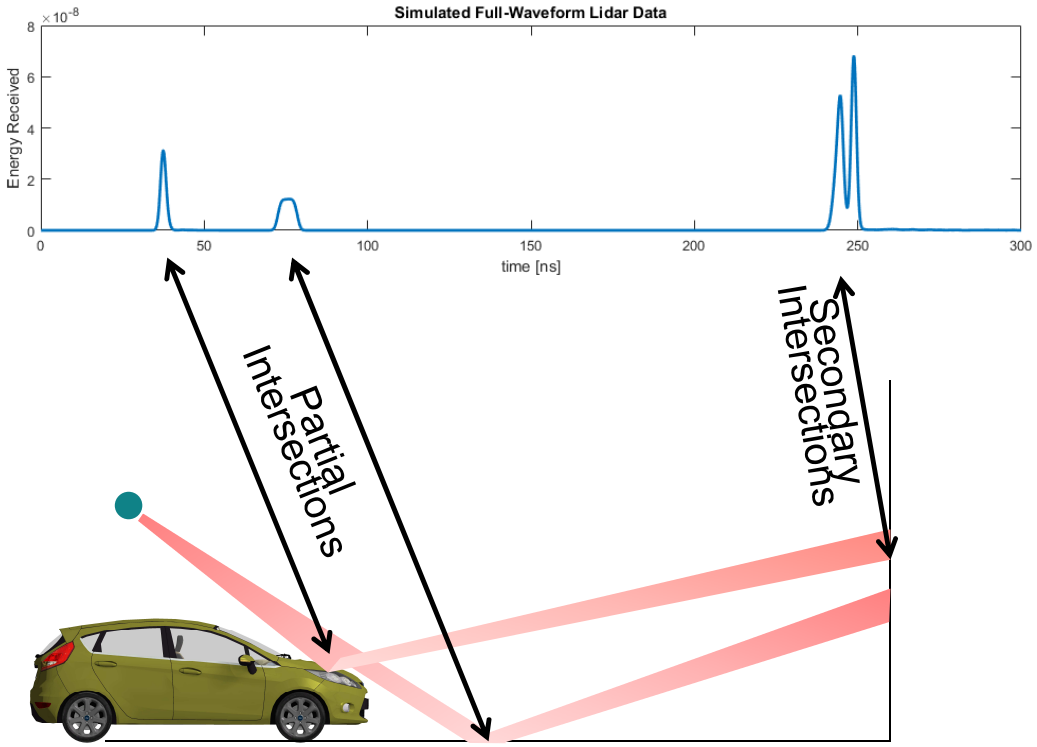






Physics Based Lidar Simulation

SIEMENS
Ingenuity for life



Thank You

Jordan Gorrochotegui - Product Manager
Mike Phillips – Software Engineer