

**rFpro & DS Products:**  
Integrated development  
software for **human** and  
**autonomously** driven  
vehicles



# rFpro & DS Products:

Integrated development software  
for **human** and **autonomously**  
driven vehicles

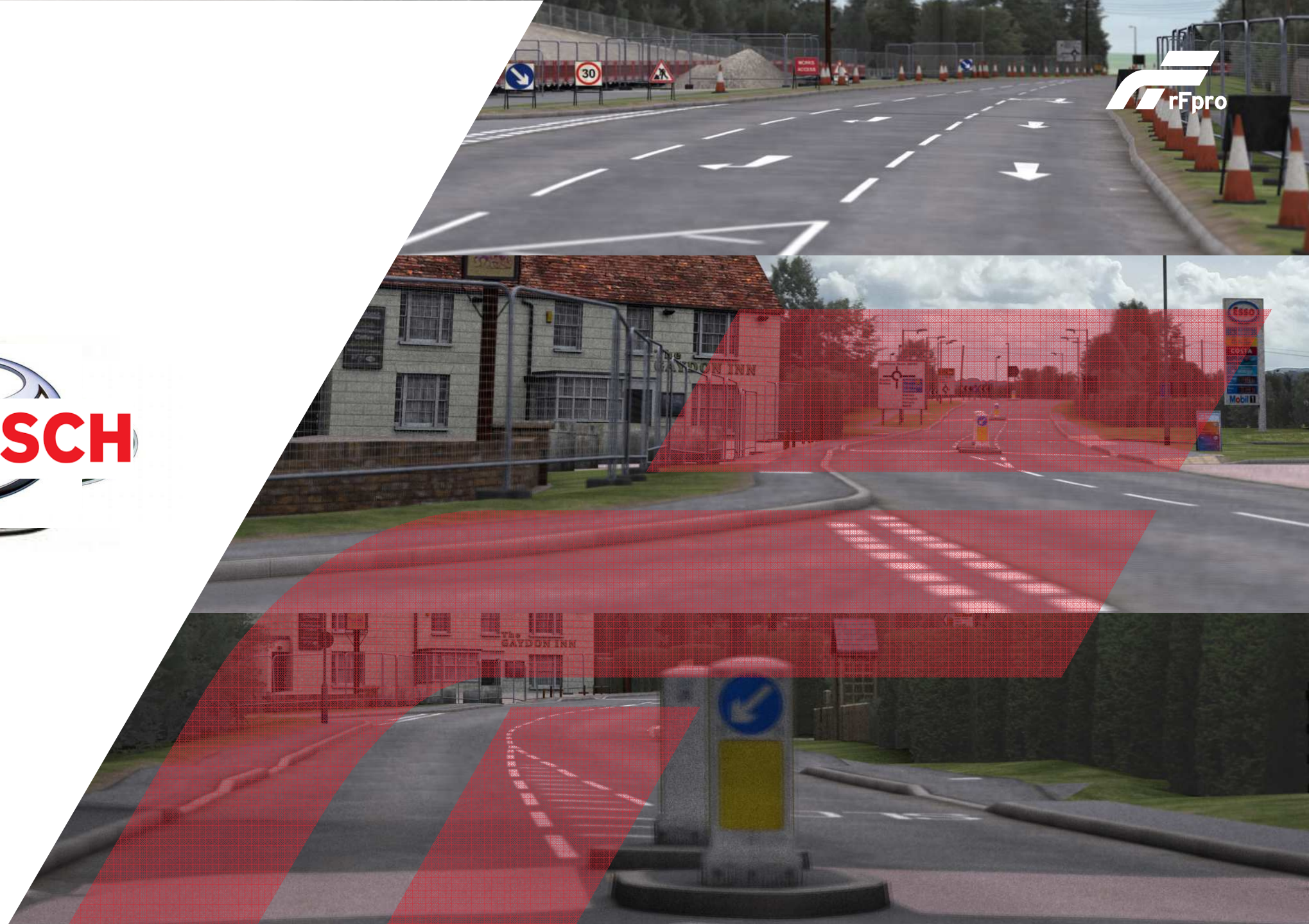


## **rFpro** The Return On Investment

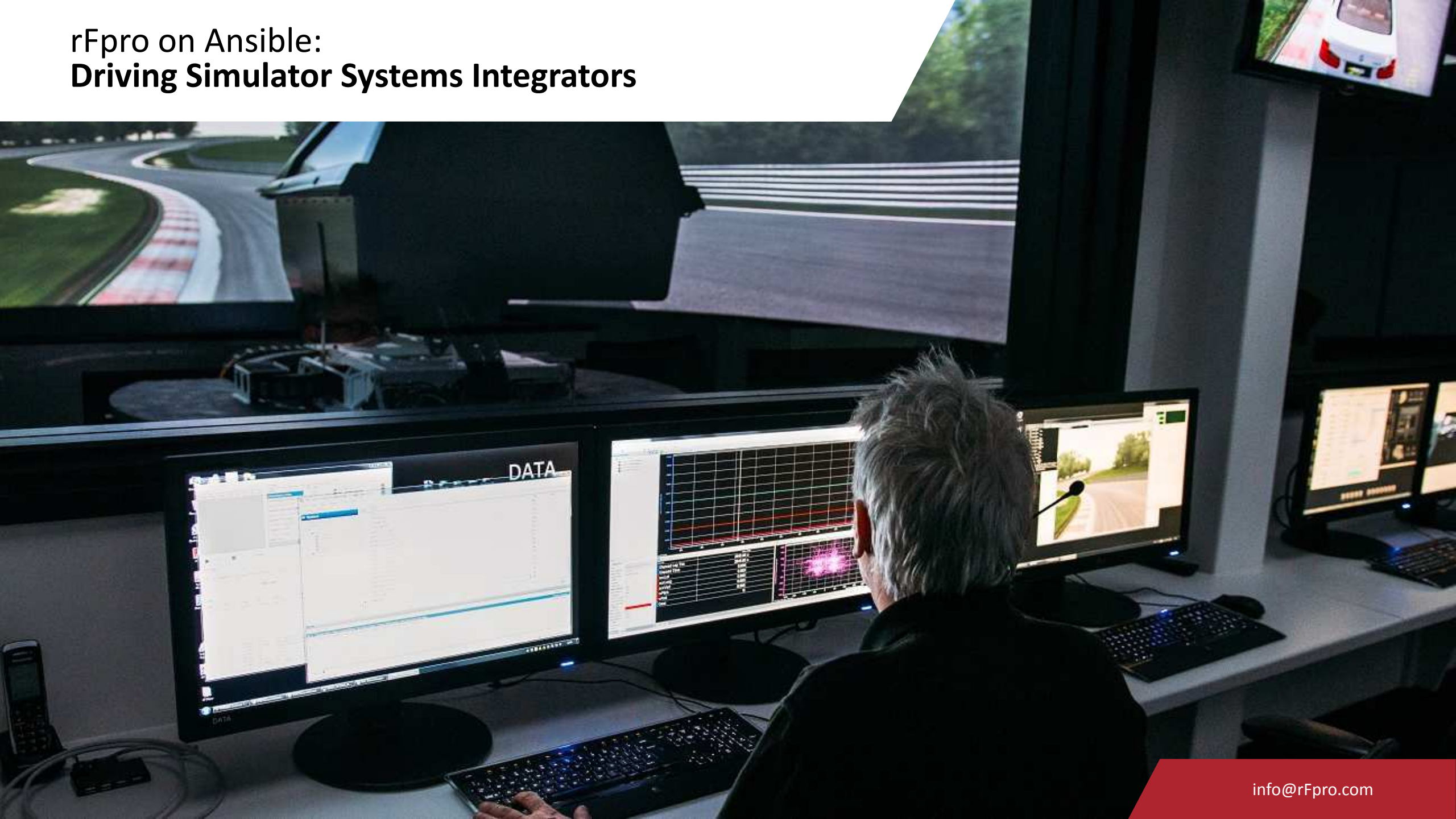
Test more in simulation

Technical leadership

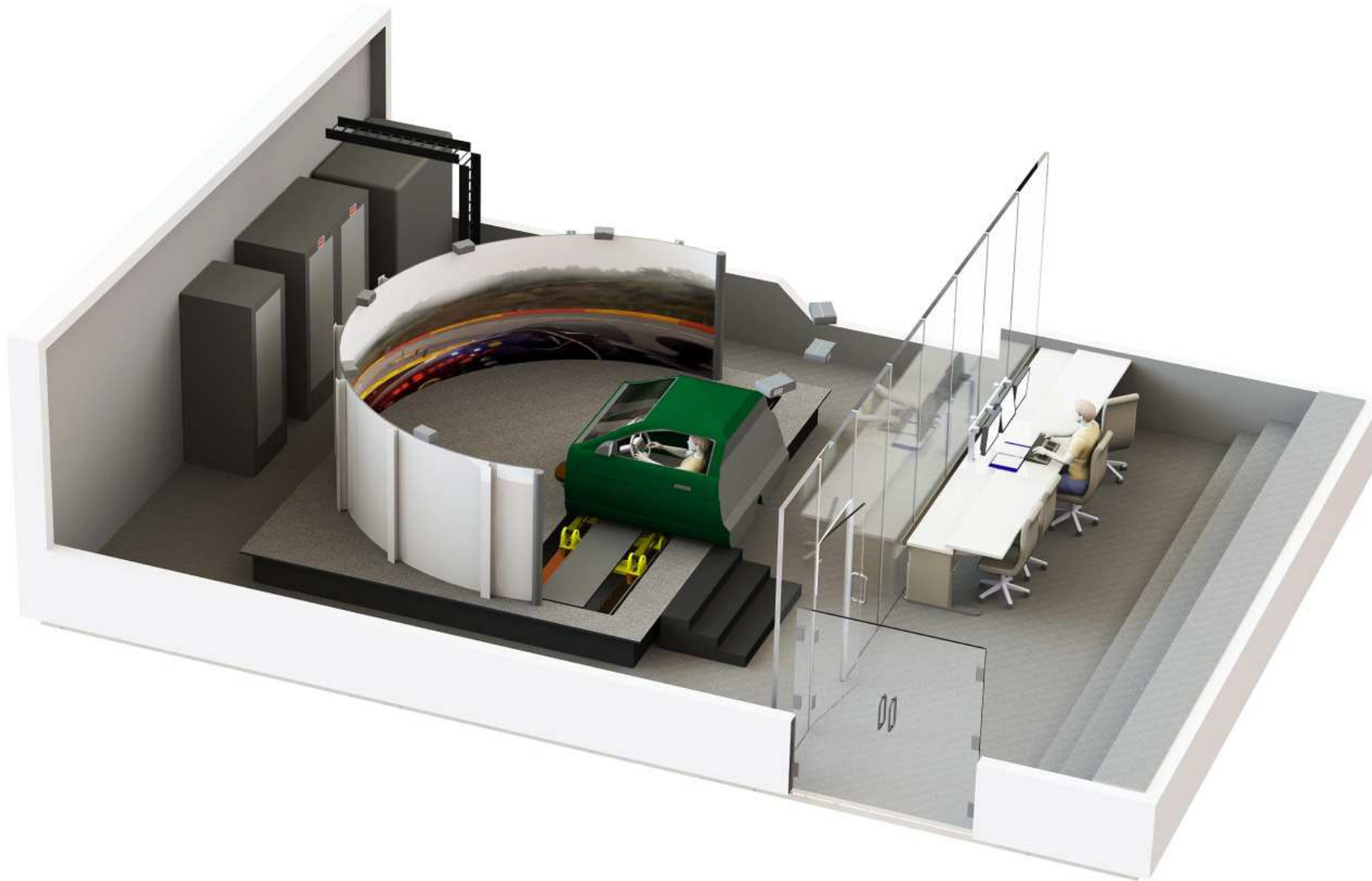
# Intro to rFpro



# rFpro on Ansible: Driving Simulator Systems Integrators



# rFpro on MTS/McLaren: Test Equipment & Driving Simulator Systems Integrators



# rFpro on AB Dynamics: Test Equipment & Driving Simulator Systems Integrators





**Voted 'Development  
Tool of the Year'**  
by Vehicle Dynamics  
International magazine



**Virtual testing of ADAS/  
Autonomous systems is  
overtaking use of passive  
simulation system testing**

**rFpro The Return On Investment**

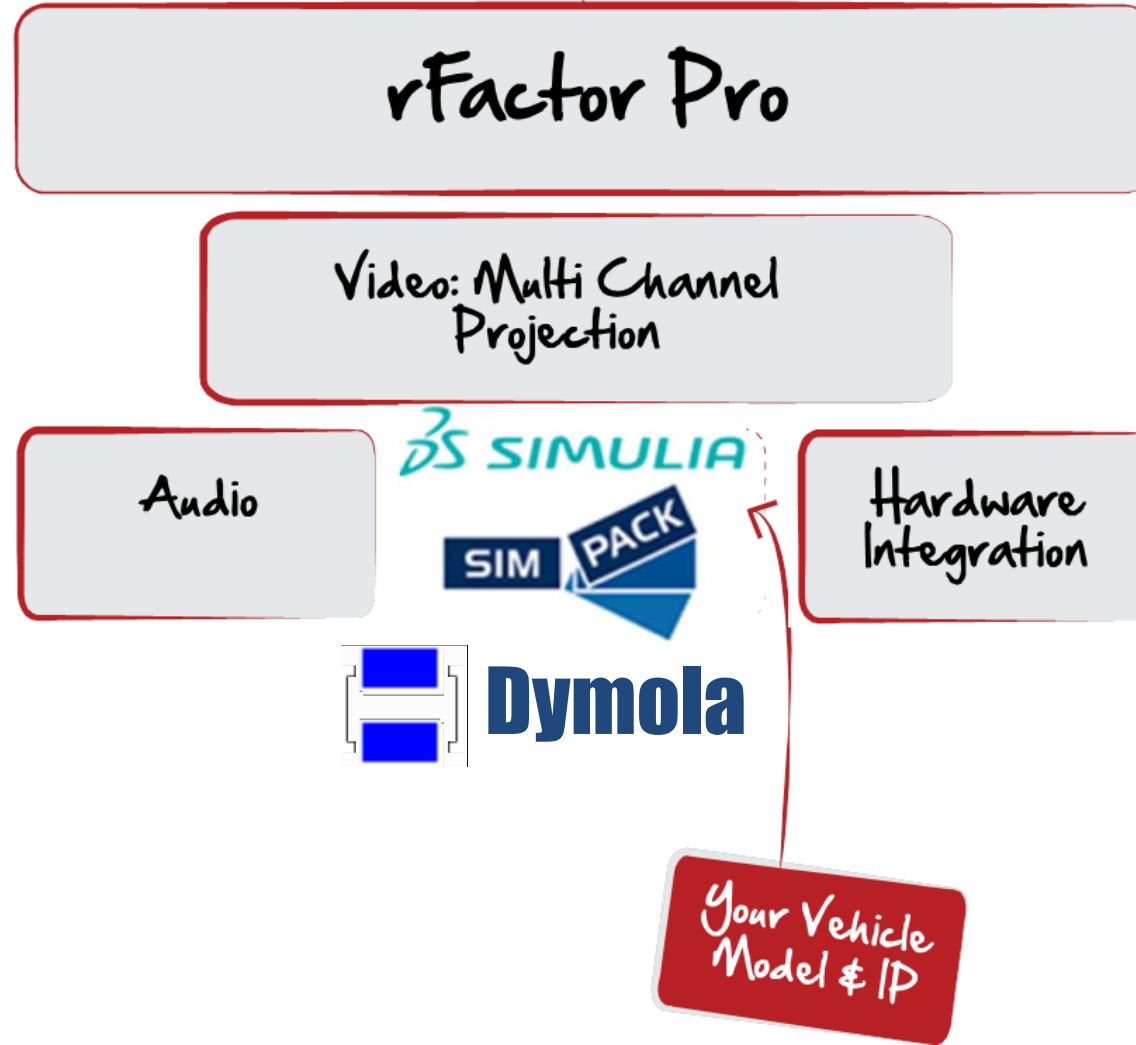
**Test more in simulation**

**Technical leadership**

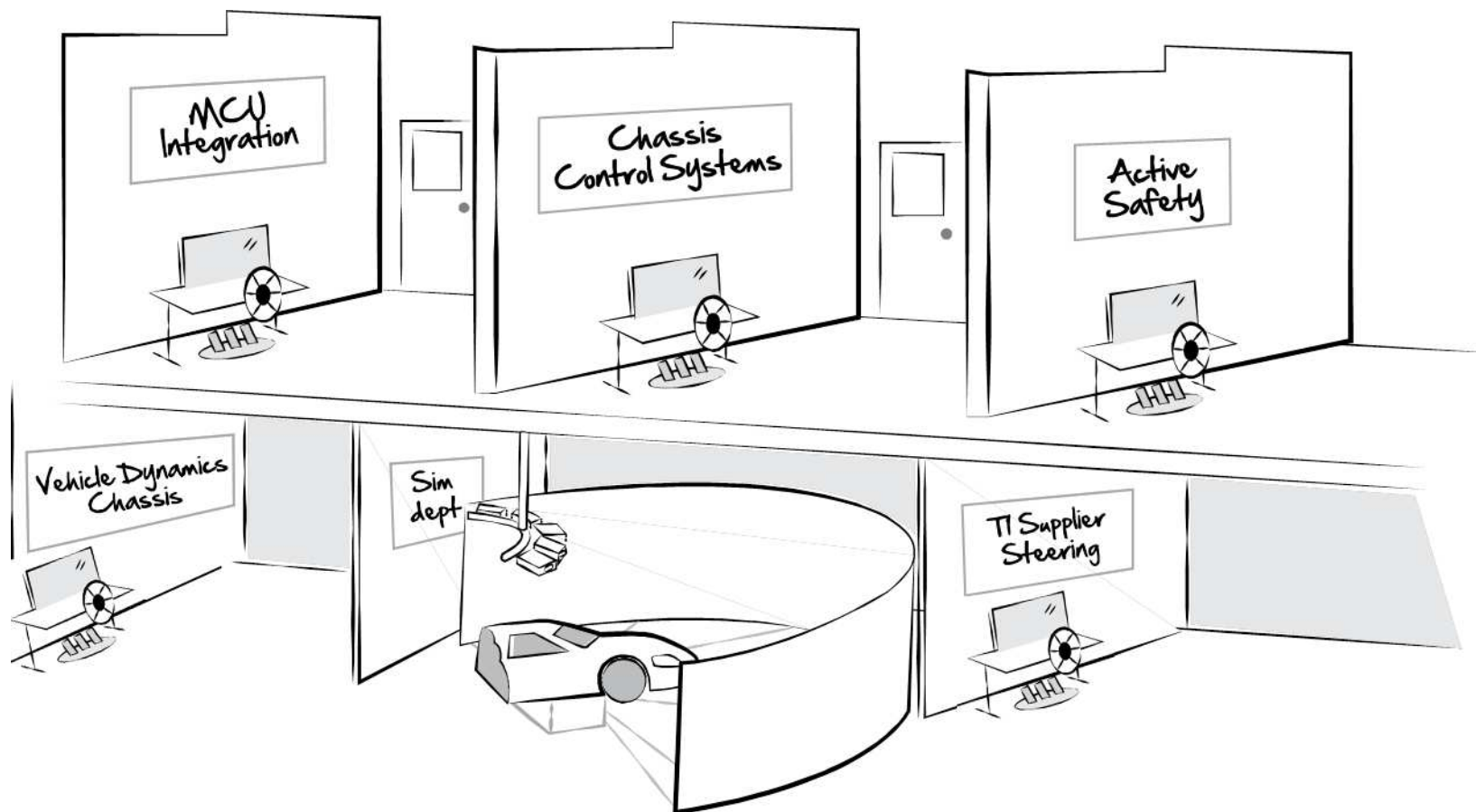
# Leverage your investment in *all* your Vehicle Models across *all* Use Cases



We can wrap around  
your vehicle model



# Leverage your investment in Vehicle Modeling

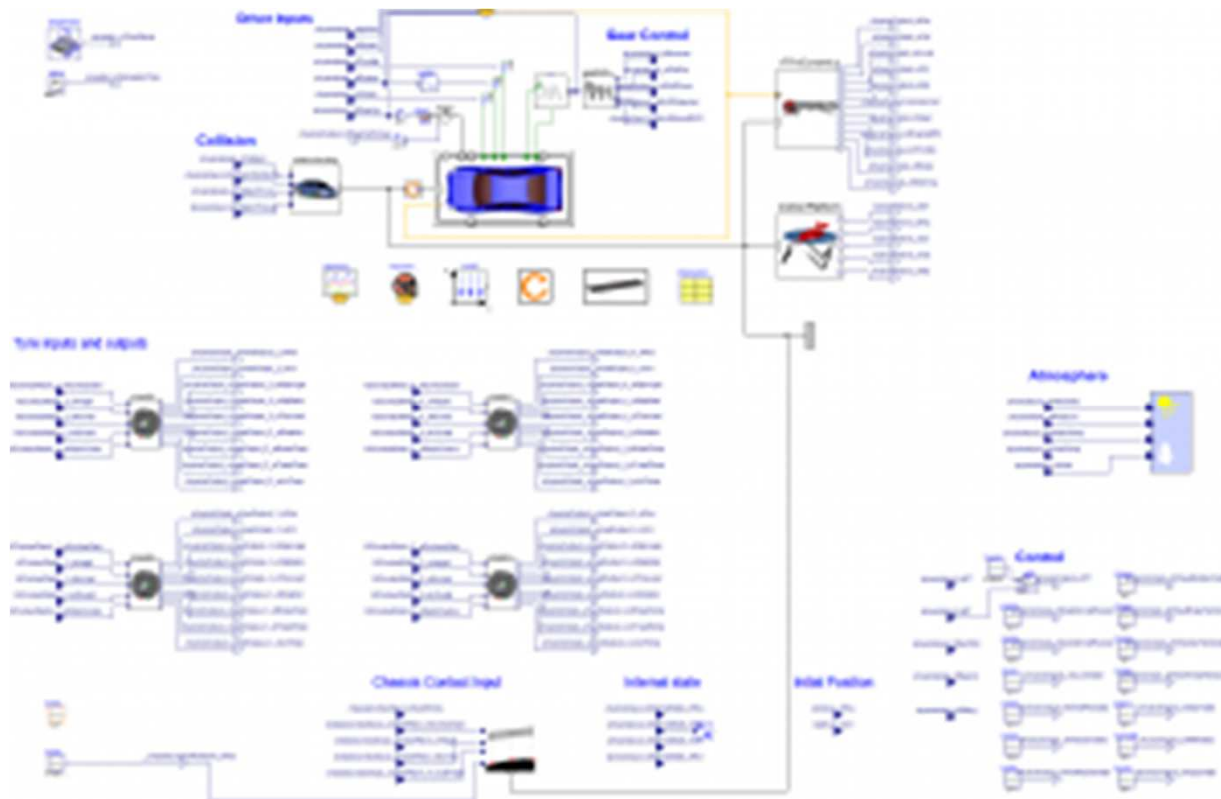




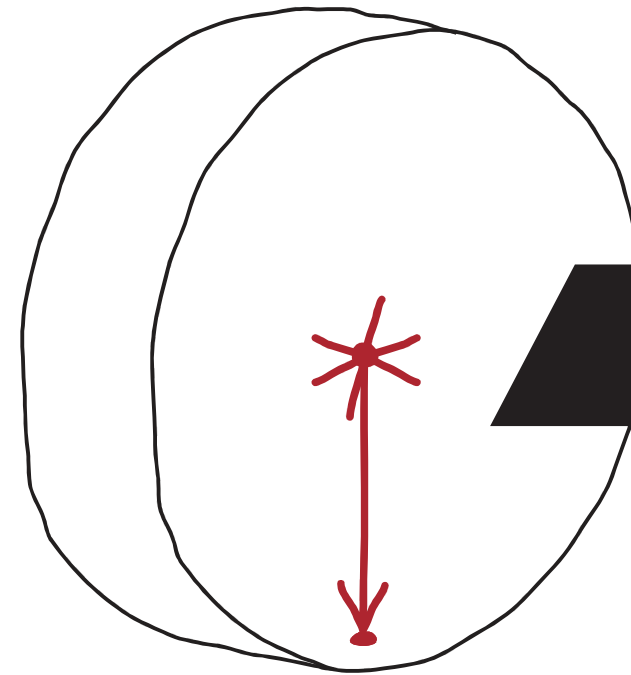
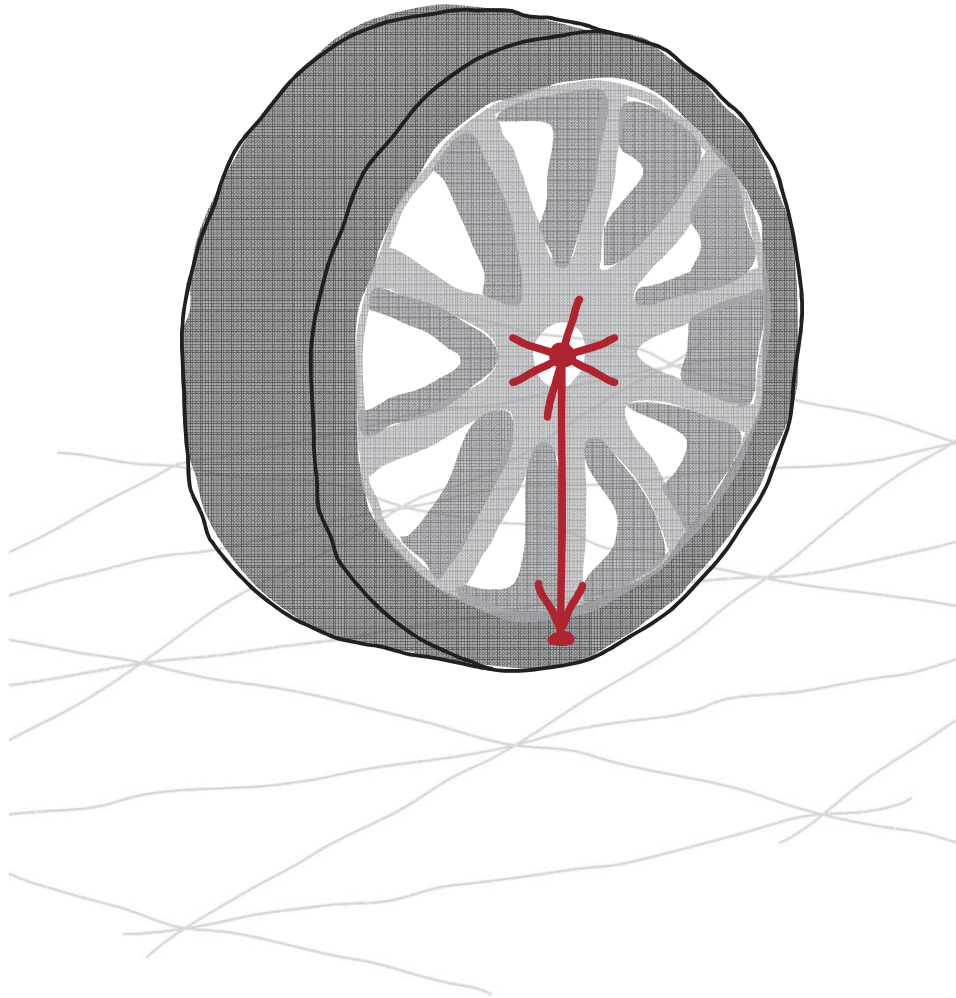
### VeSyMA – Driver In The Loop

Integration between Dymola developed vehicle dynamics models and rFpro.

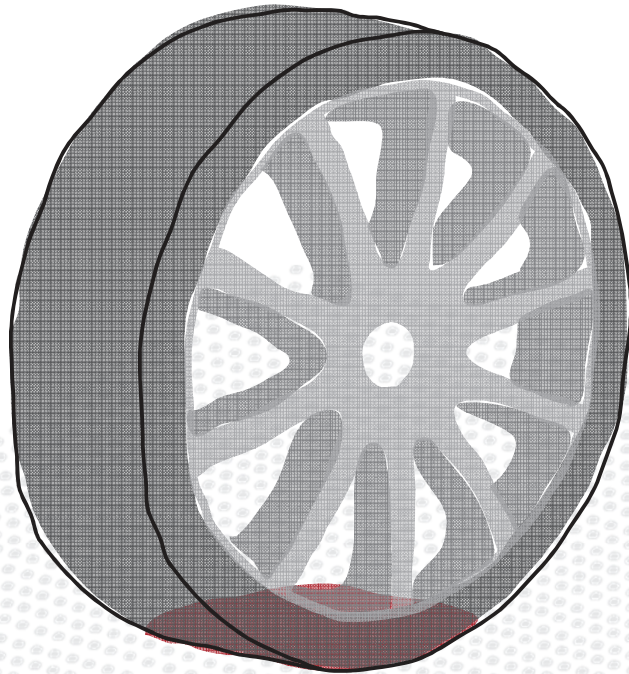
Using this solution, the vehicle model is plugged into a model template in Dymola and then functions guide the user through the export process and produce a PTWinSim or vTAG app ready to be plugged into rFpro.



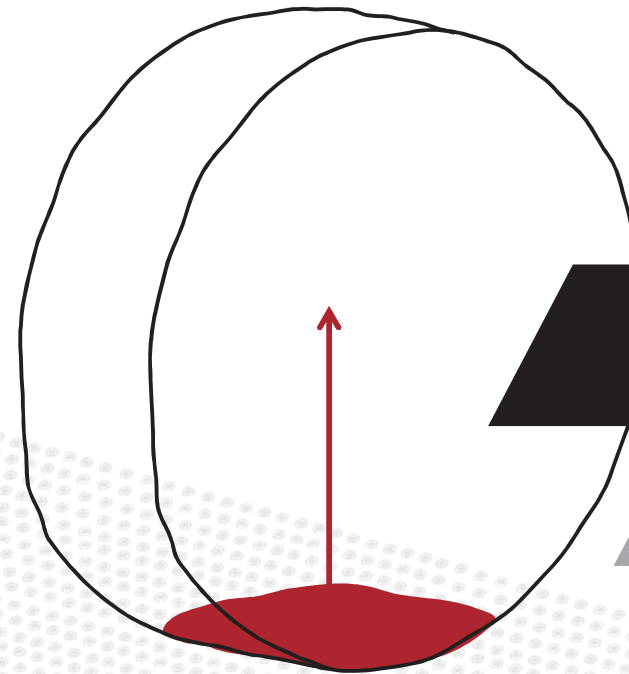
# A traditional polygon contact patch calculation



**Single vector  
hub-to-polygon**



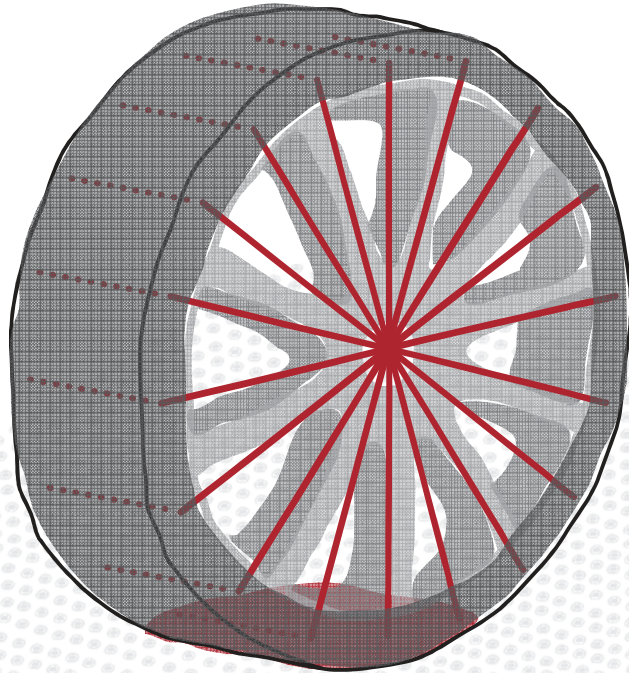
**Accurate contact patch**  
centre for force resolution



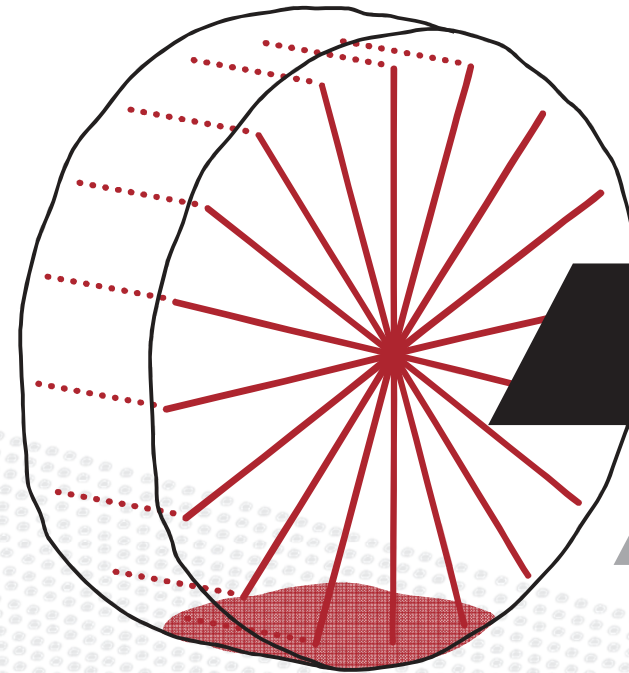
**Superior bandwidth/fidelity over**  
traditional polygon contact patch

**TERRAINSERVER<sup>HD</sup>**

For Pacejka /  
Magic Formula



**Ideal for physical tyre models**  
with custom envelope calculations



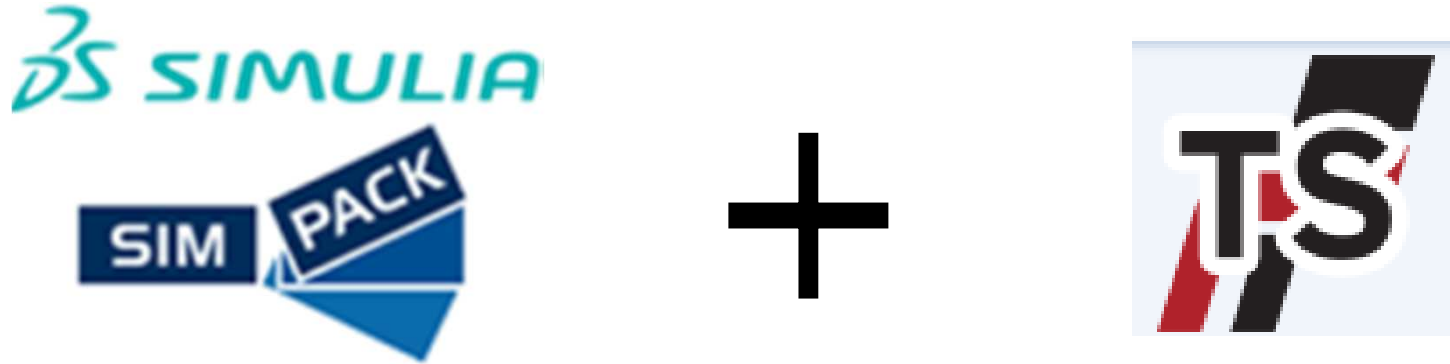
**TERRAINSERVER<sup>HD</sup>**

**For Physical  
tyre models**

**Works offline allowing simulation**  
to benefit from HD road surface

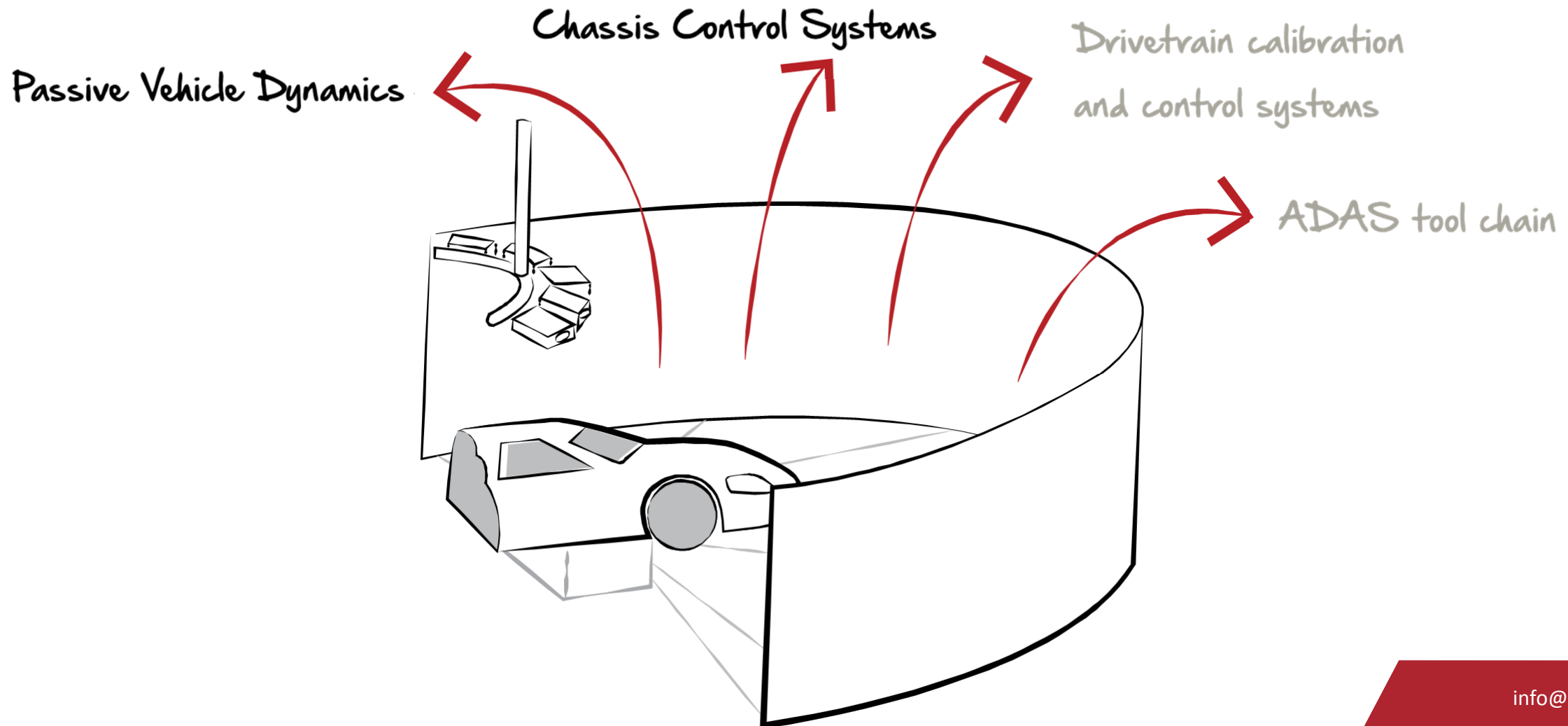
# rFpro + SIMPACK

## High Definition Road Elements with TerrainServer



### **rFpro TerrainServer is a built in Road Element in SIMPACK**

- High Definition LiDAR scanned road surfaces fed to each wheel
- Built in volumetric intersection enveloping model  
or  
Custom Enveloping API available for user's own code
- Large library of datasets available for public roads, proving grounds, test and race track facilities worldwide with matching high definition graphics models for driver in the loop testing



~~Test more in simulation~~  
Test more in simulation

Nürburgring Nordschleife:  
Entire 20.8km mapped to 1cm  
resolution in x and y  
with sub-millimetre accuracy



Public road, European.  
50km mapped to 1cm resolution in x,y  
1mm accuracy in z

# rFpro CUSTOMER CASE STUDY 1: Applus IDIADA



*Transport Engineer* article on **Applus IDIADA** project for **Hyundai**:

A wide-angle, first-person perspective view of a virtual race track. The track is dark asphalt with white lane markings. In the distance, there are orange traffic cones and a blue building. The sky is a clear blue with a few wispy clouds. The track is bordered by a metal fence and a grassy area.

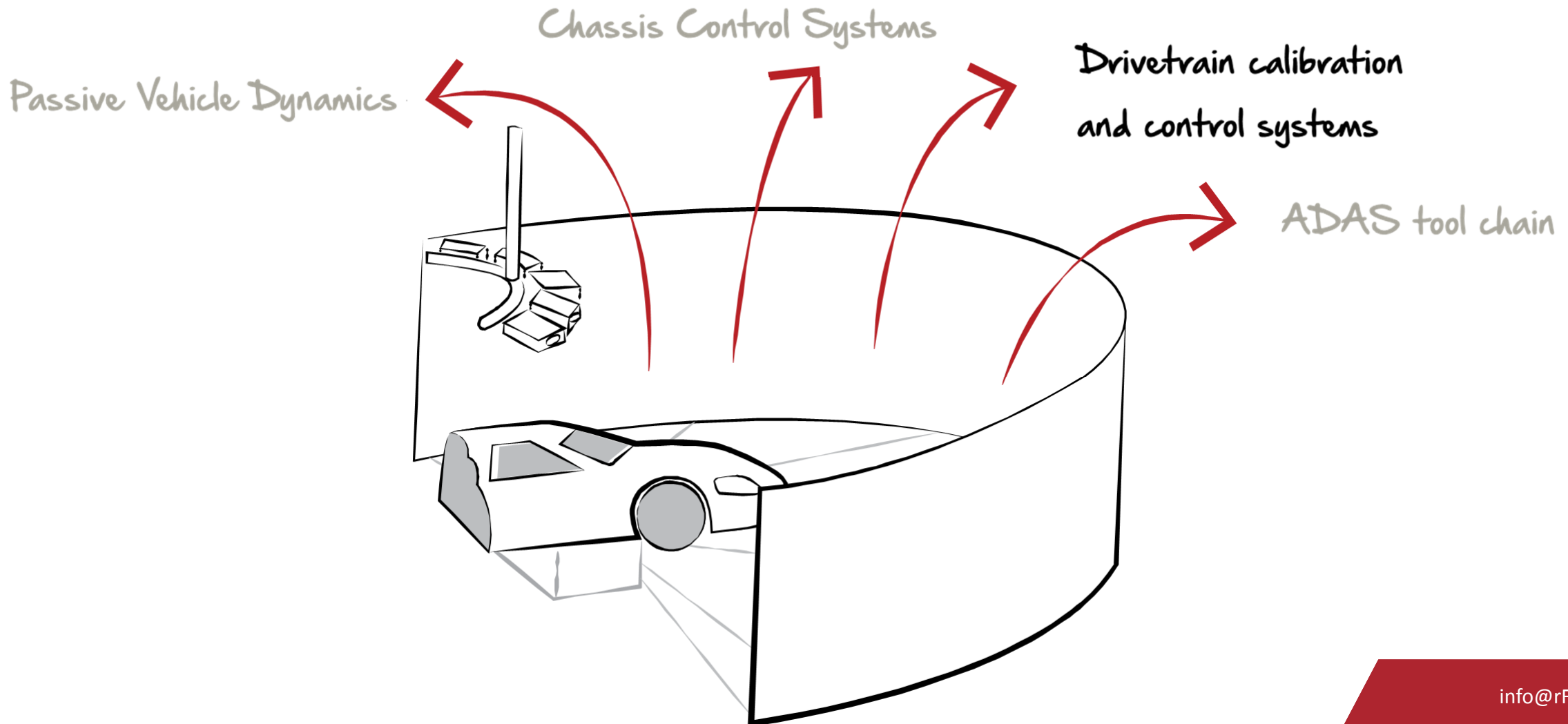
“In the space of 10 days we were able to evaluate around 25 different vehicle configurations using three professional drivers”

“More importantly, because of the high fidelity visual cueing using rFpro software, driver immersion was very convincing which led to good correlation between their subjective ratings and the objective data”



GUIDO TOSOLIN  
MANAGER - CHASSIS  
DEVELOPMENT AND  
VEHICLE DYNAMICS  
SIMULATION

“For the first time, we have generated so much data that we are able to use statistical methods effectively to interpret the results,”





## *Automotive Engineering (SAE) article:*

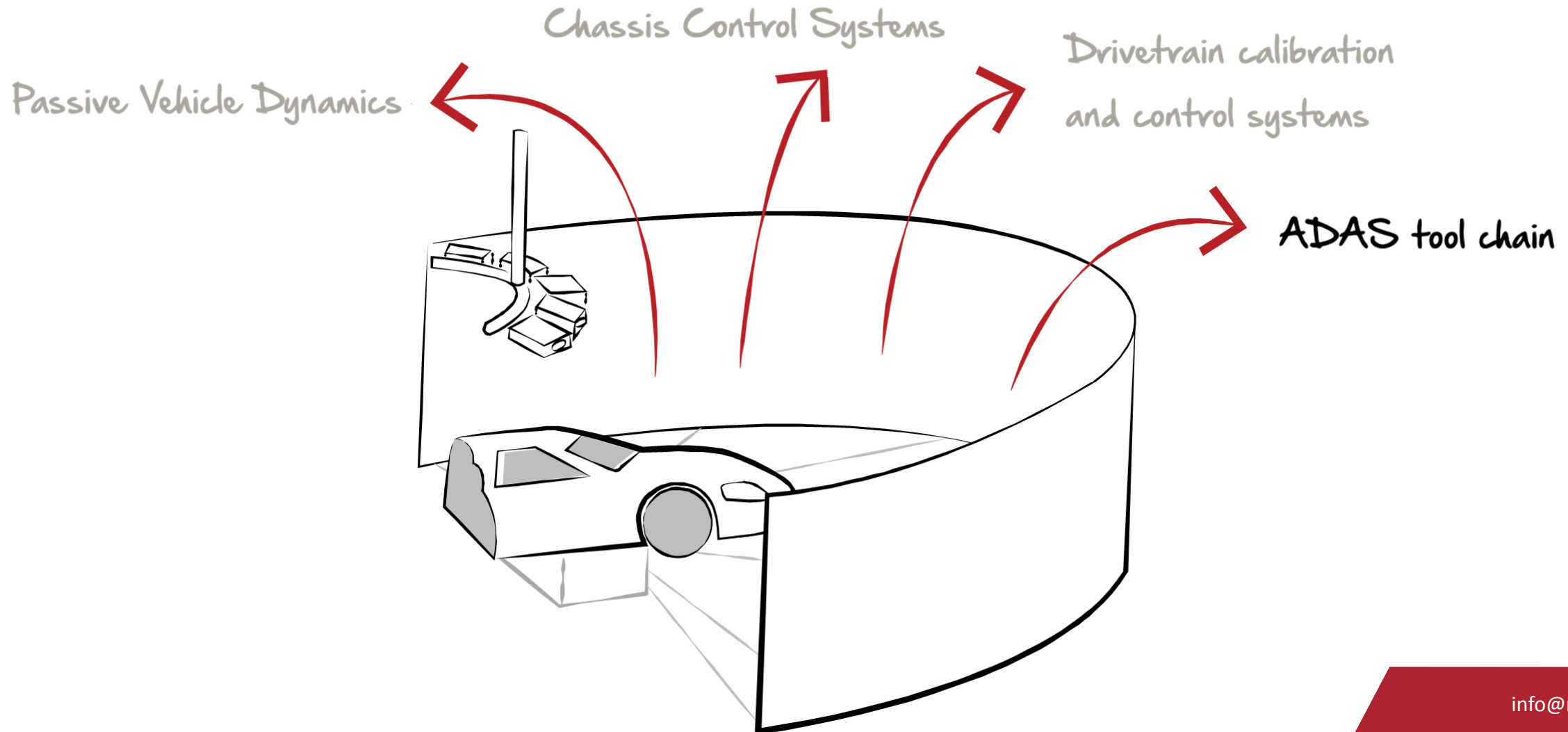
**ERIK BOGNER: MANAGER FOR  
DRIVEABILITY AND SIMULATION,  
ENGINEERING & TECHNOLOGY  
AT AVL**

“ AVL ESTIMATES THAT OVER 30  
PERCENT OF THE COSTS INCURRED IN  
DEVELOPING DRIVING ATTRIBUTES  
COULD BE SAVED THROUGH  
FRONTLOADING THE ENGINEERING  
ACTIVITY ON A DIL SIMULATOR ”



“ AVL chose rFpro software because it provides seamless integration of the vehicle model and the best level of immersive experience for the driver conducting the assessment testing, ”  
**ERIK BOGNER**

“ Simulation software from rFpro not only provides the greatest possible graphical realism for the driver but also the ability to ‘feel’ events such as gear shifts and vehicle movements and experience them in ways that are not possible with offline desktop simulation. ”  
**ERIK BOGNER**



# Why Driver-in-the-loop for ADAS and Autonomous?

DLAD (Deep Learning Autonomous Driving)

DLAD Training, Testing, Validation

ADAS (Passive)

ADAS (Active)

Vehicle Localisation

Test with a Human driver

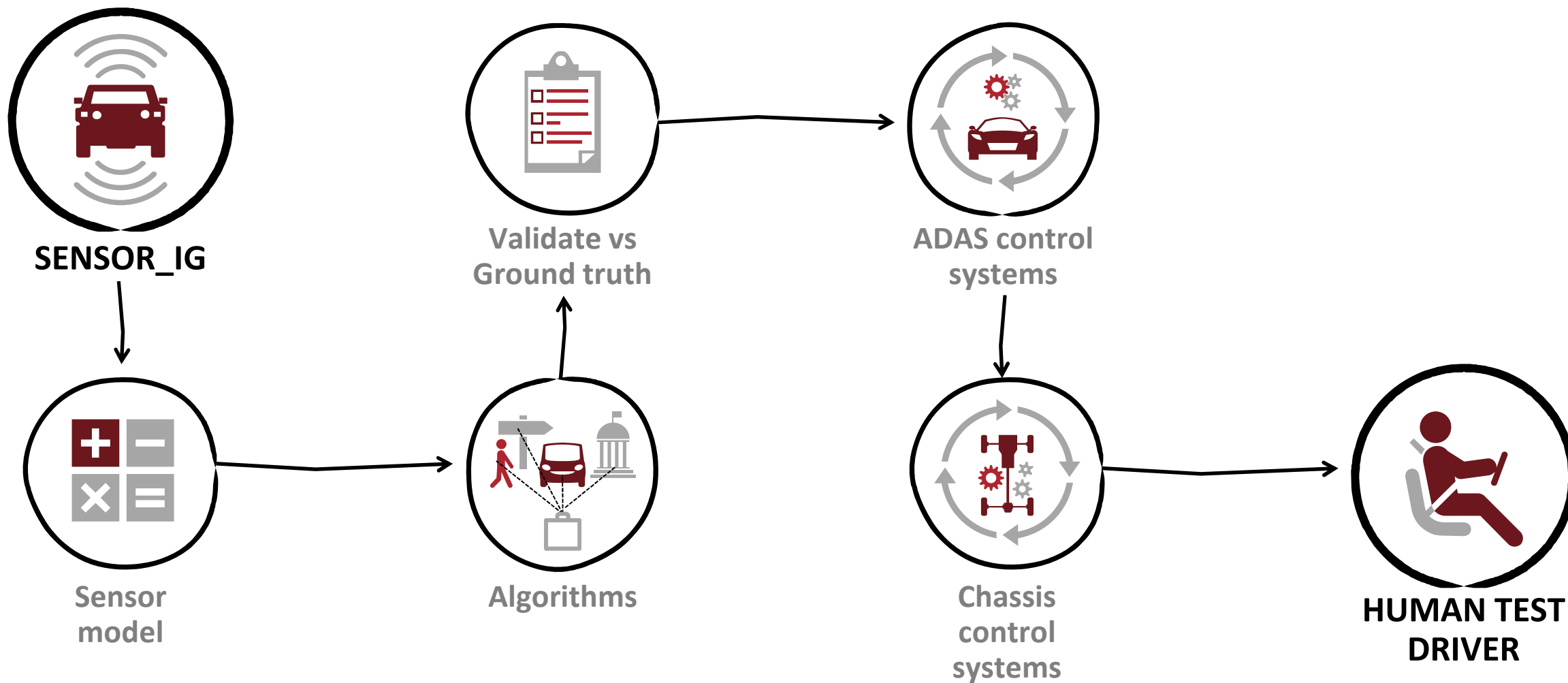
Test with a human passenger

Human car share virtual road with DLAD / ADAS

A vehicle dynamics driving simulator offers representative behaviour, **even** in dynamic manoeuvres

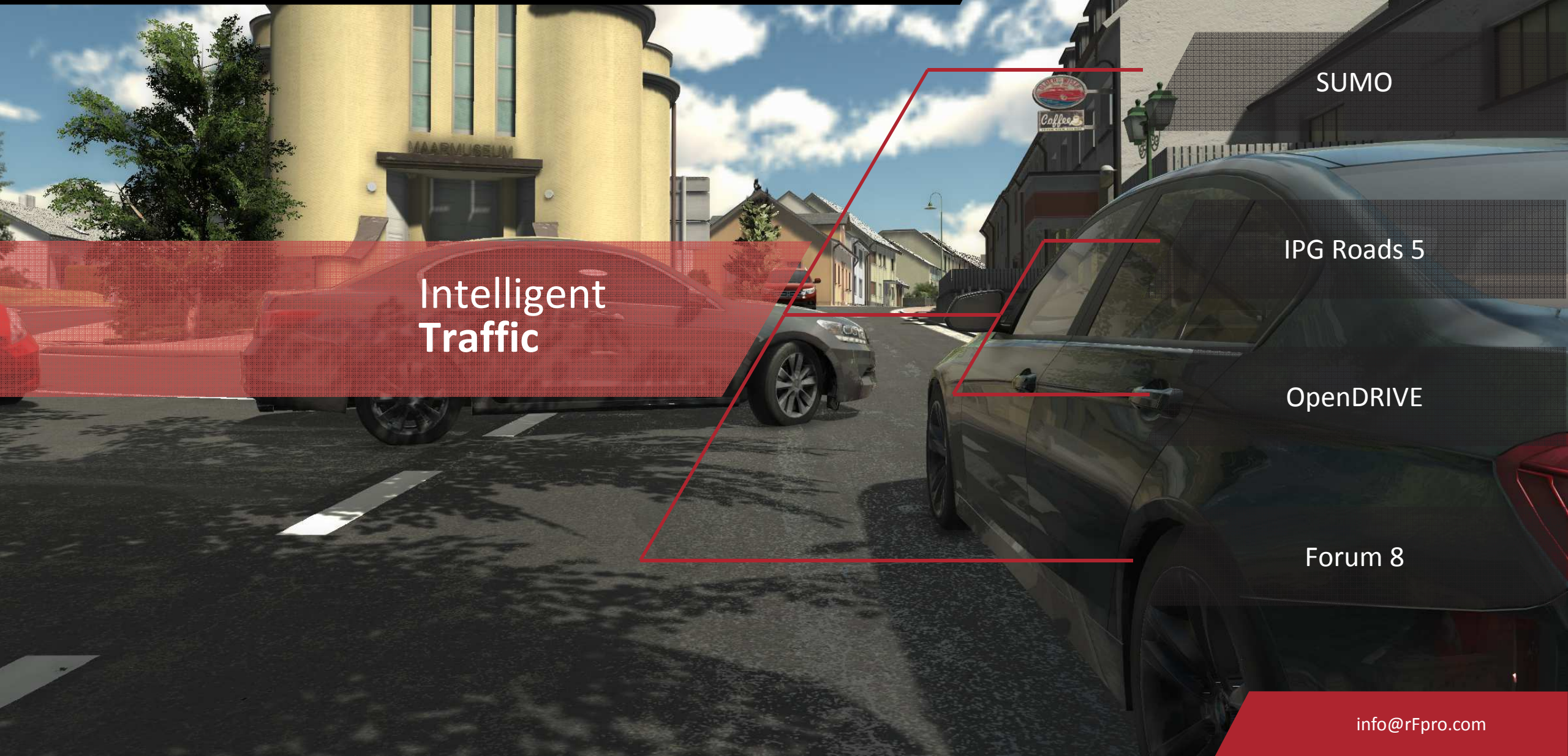


# SENSOR\_IG Testing entire toolchain



# Road Networks

## OpenDRIVE, SUMO, IPG Roads 5, Forum 8



Intelligent  
Traffic

SUMO

IPG Roads 5

OpenDRIVE

Forum 8



# Intelligent Traffic – Pedestrians, Cyclists, Animals



# Intelligent Traffic – Pedestrians, Cyclists, Animals



# Intelligent Traffic – Pedestrians, Cyclists, Animals



# Intelligent Traffic – Pedestrians, Cyclists, Animals





R. LOCKE & SON  
Independent Family Funeral Directors  
Established in 1890

Moreton  
Morrell  
Lighthouse  
←  
A50



# Low light affects camera Reflections



All objects can reflect  
Reflections in vehicles' paint and glass



# Advanced Lighting model

## Reflections confuse white line detection



rFpro  
Physically based materials



rFpro  
**Physically based materials**





**rFpro The Return On Investment**

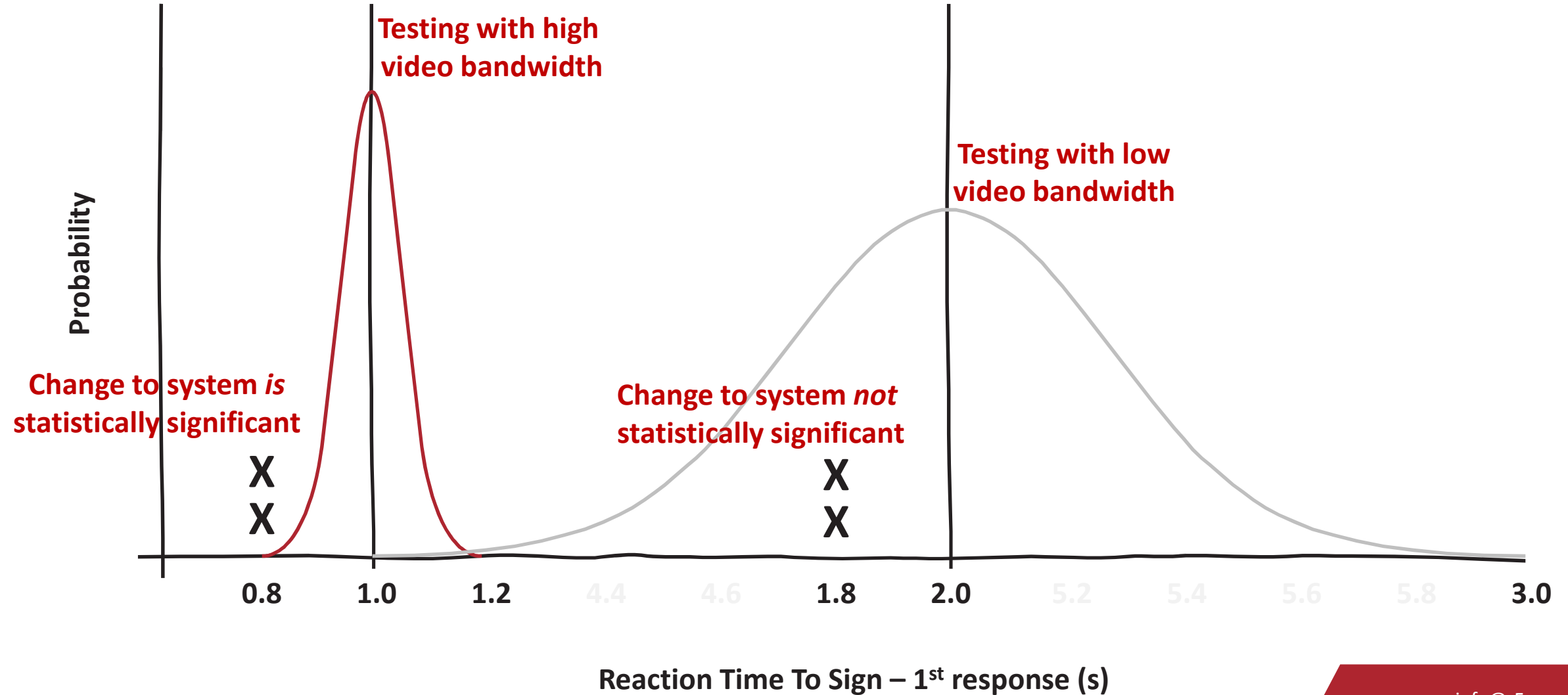
**Test more in simulation**

**Technical leadership**

HiDef Video bandwidth  
**Exercise toolchain with realistic lighting & atmosphere**



# Importance of consistency In Simulation quality



# New HiDef examples



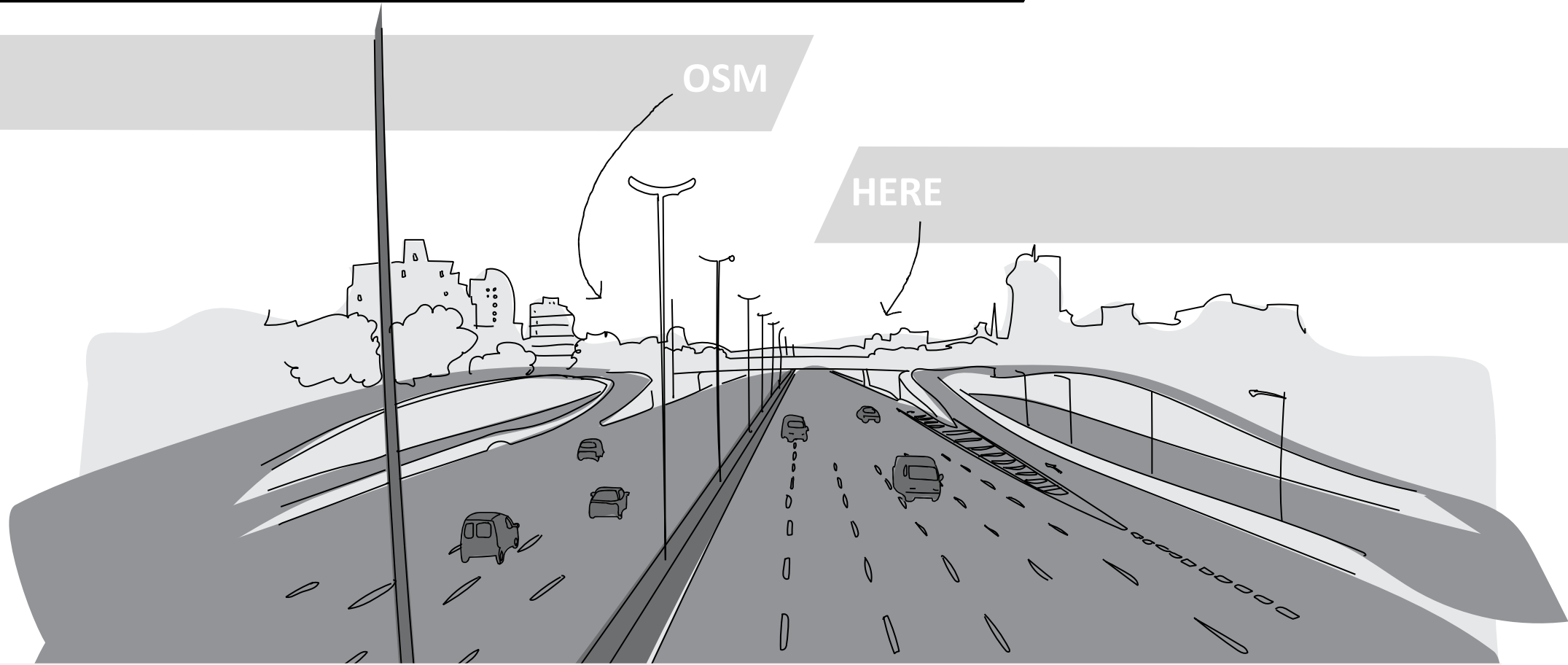
# New HiDef examples



# New HiDef examples



From 'OSM' & 'Here'



Statistically **accurate scenery** over imported road network

# Statistically accurate Digital Road Models

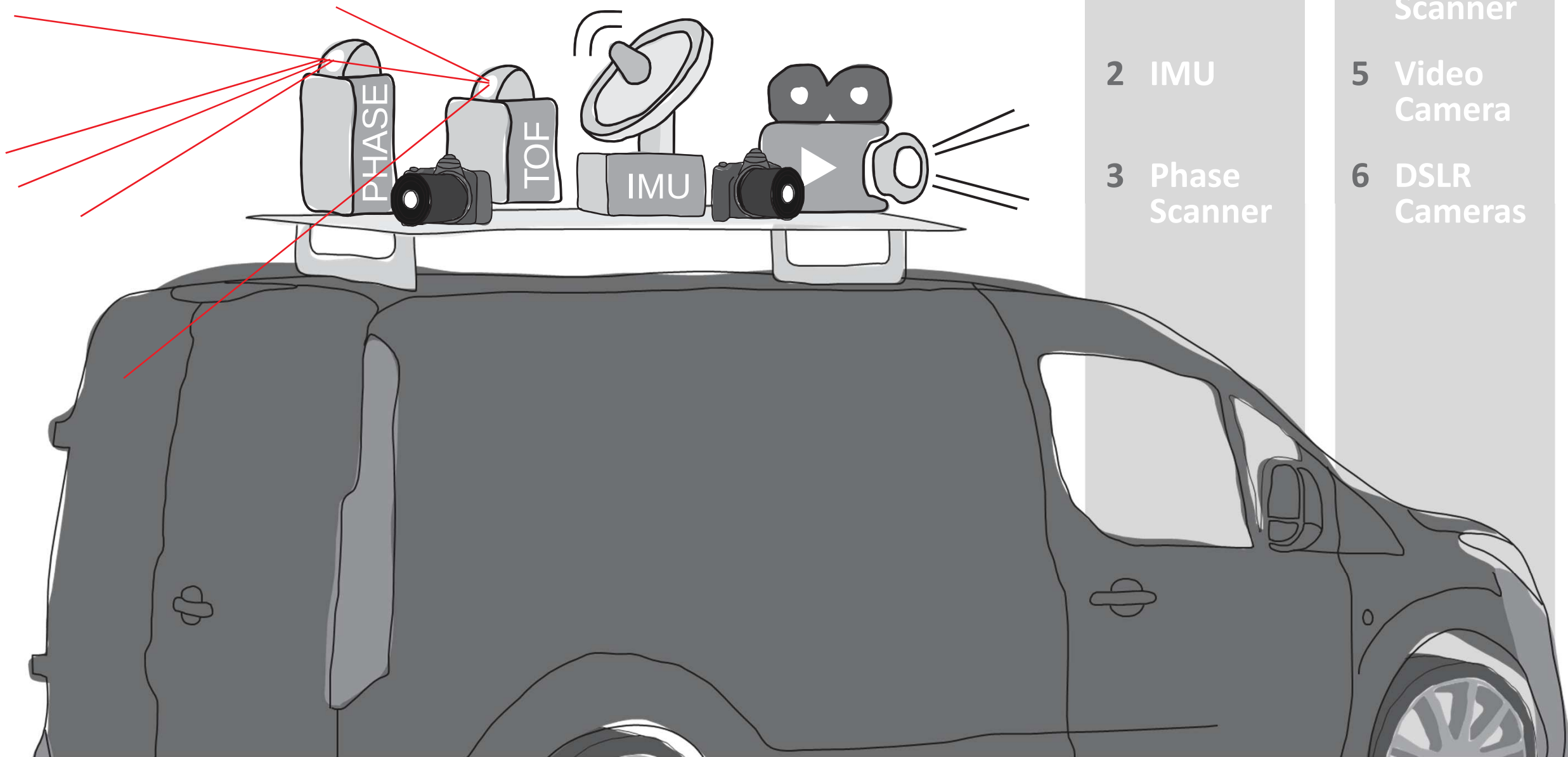


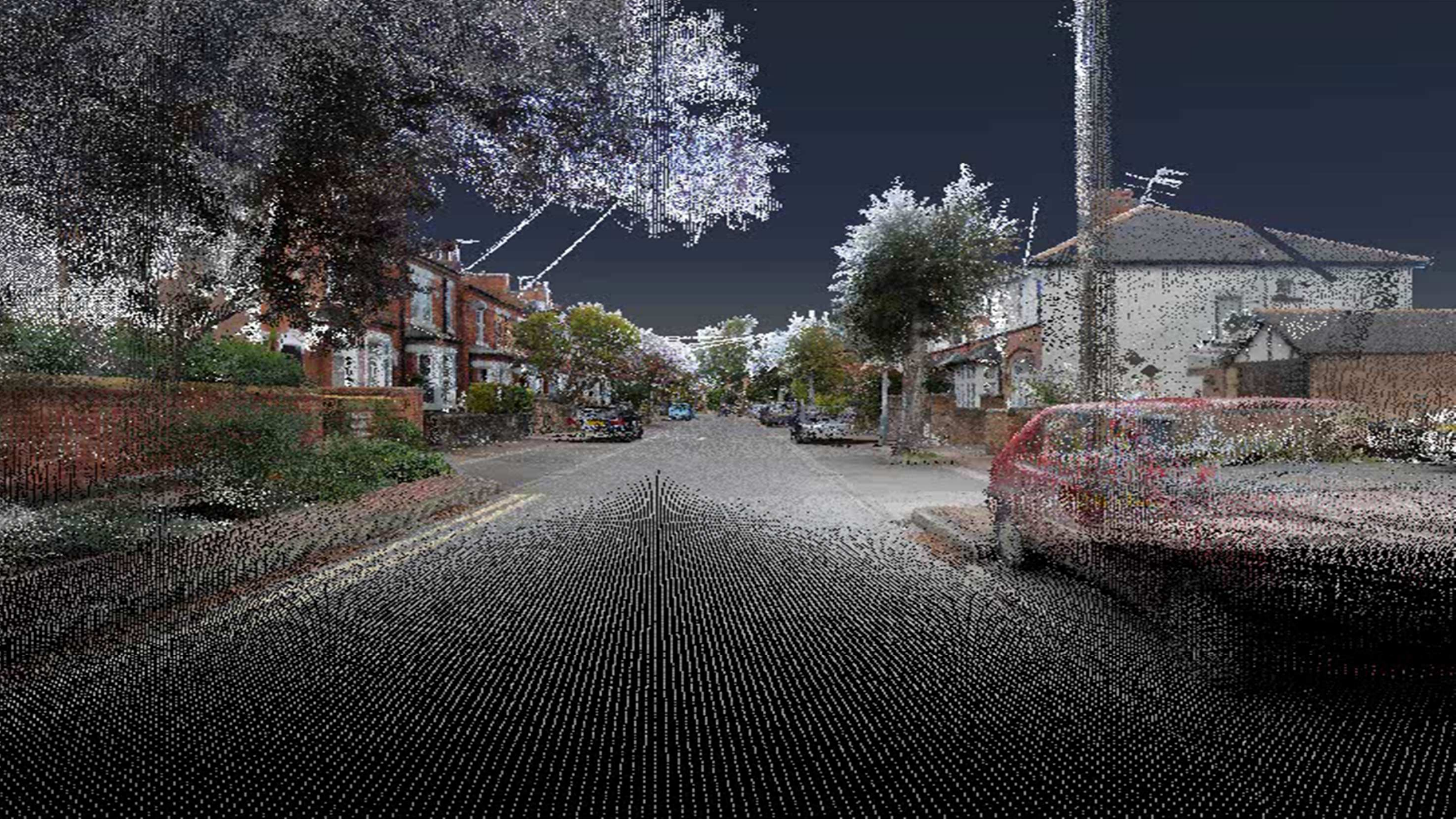
Statistically **representative**

A wide, empty asphalt road stretches into the distance under a cloudy sky. The road is flanked by grassy areas and trees. A fence is visible on the left side. The sky is filled with soft, grey clouds, and the overall lighting suggests an early morning or late evening setting. The road surface is dark and textured, with a white dashed line marking the center. The horizon is visible in the distance, where the road meets the sky.

US Interstate,  
Early morning, high speed run

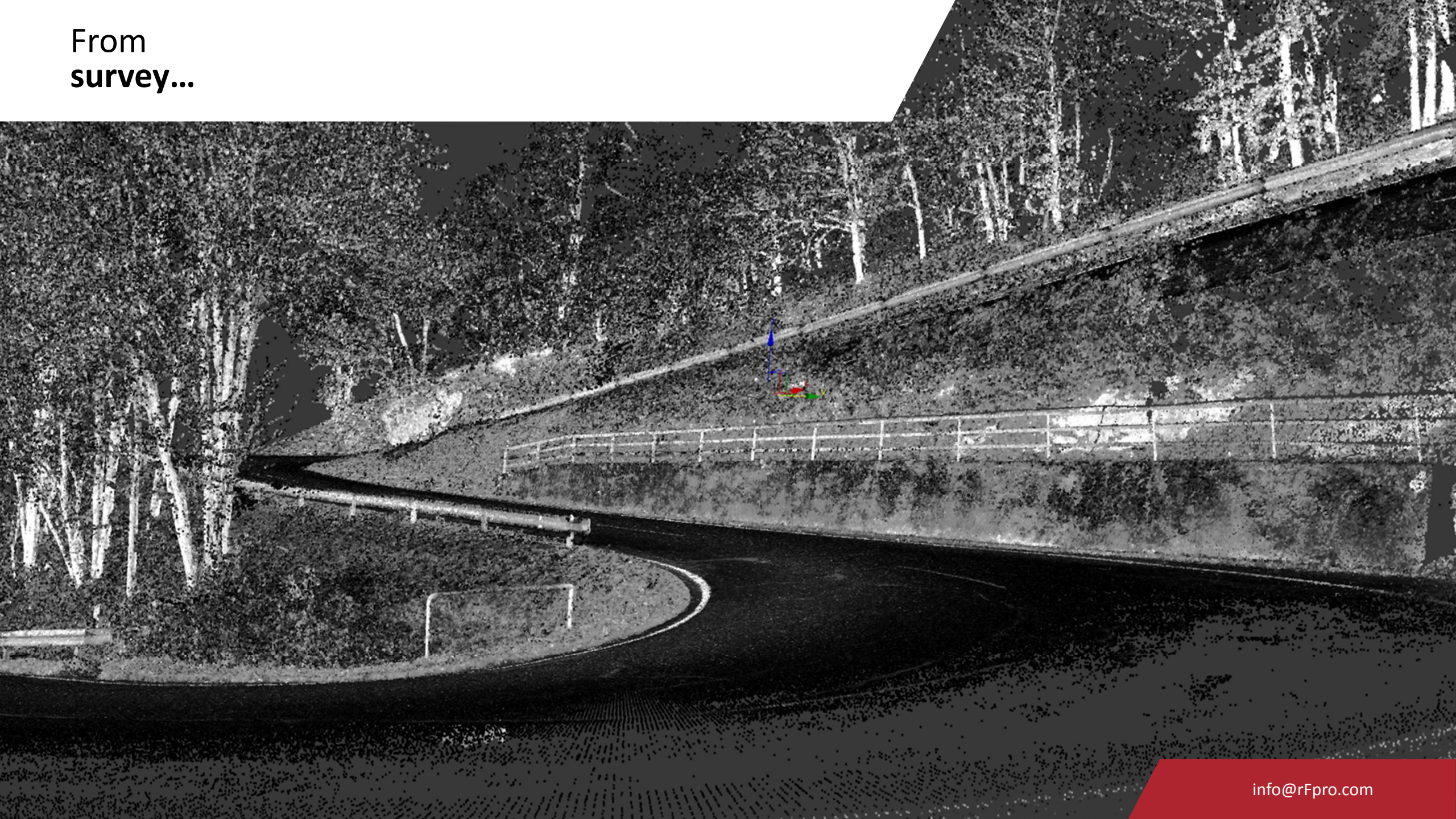
# Replicating reality over LiDAR and Spherical Photography







From  
survey...



...to digital  
road model



## **rFpro The Return On Investment**

**Test more in simulation**

**Technical leadership**

# rFpro & DS Products:

## An Introduction to rFpro

### Driving Simulation and Solutions

Any questions?