

Emulation of ADAS Sensor Fusion Targets



Michael Konrad
CEO Konrad GmbH

Worldwide Locations



Konrad Technologies



Advanced Driver Assistance Systems (ADAS)

Autonomous Driving is Trending

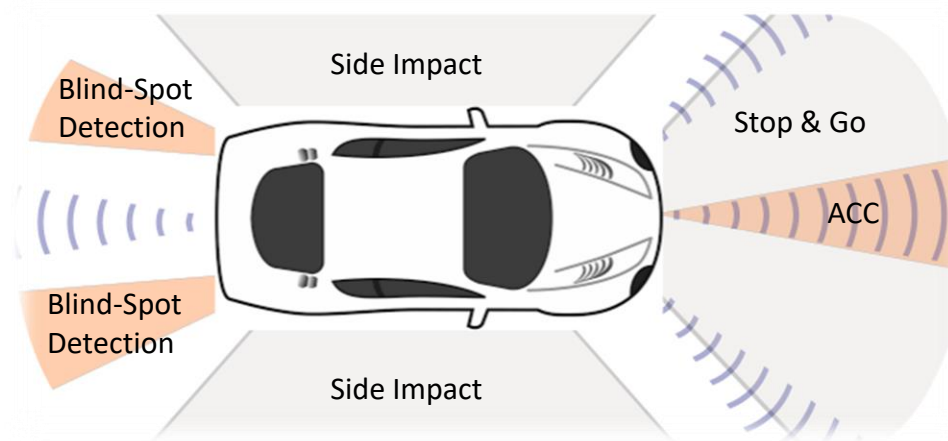
Typical cars will contain a variety of sensors:

- Camera
- Lidar
- Radar
- Ultrasonic
- V2X
- GNSS



Advent of Sensor Fusion

- Sensor Fusion combines the input of these sensors
- Data from the sensors will be transferred to ECU
 - Raw data or object data (reduced data volume)
- ECU decide the response of the car dependent on sensor data



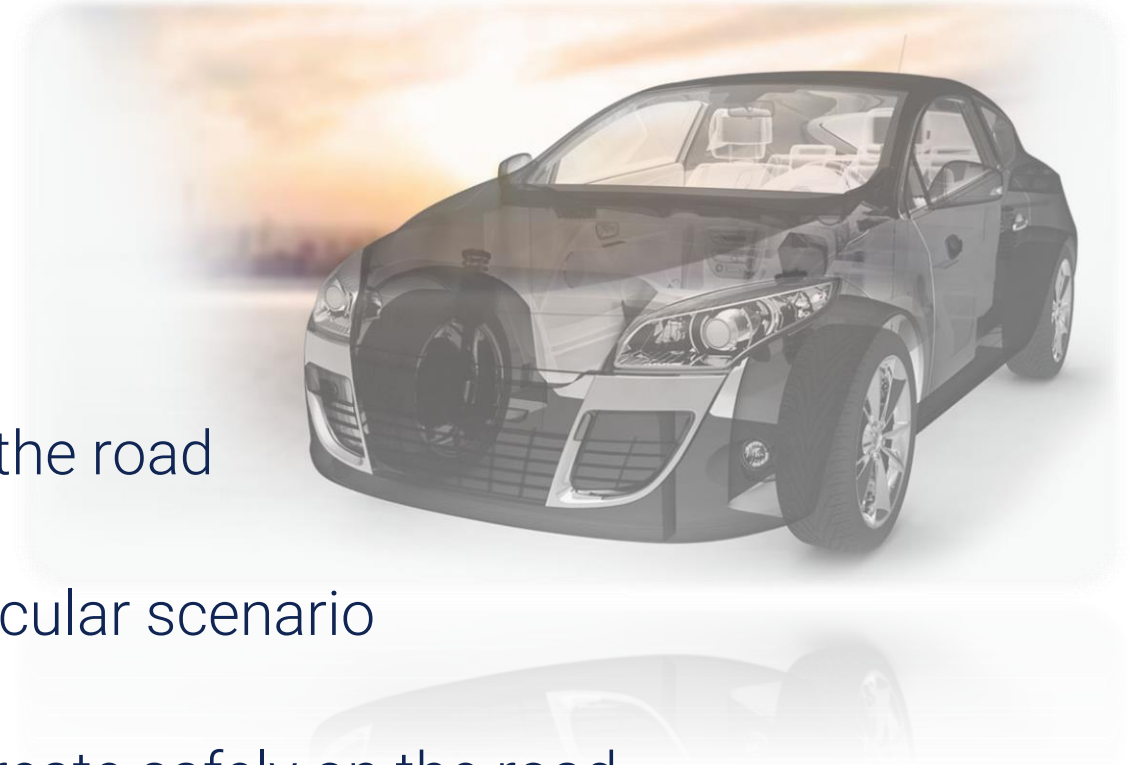
Challenges of Validating Sensor Fusion Systems

- Each sensor has a unique operating principle.
 - Target Generation requires special hardware, interfaces, etc.
- The fusion of all sensor data has to be validated.
- Even a small software change, on the sensor side, should trigger a complete sensor fusion test
- Government regulated safety requirements must be upheld (ex: ASIL-D)

Advantages of Sensor Fusion Target Emulation

Simulation of targets:

- Allows testing ADAS in the laboratory
- Saves time by eliminating test driving on the road
- Creates a repeatable test frame of a particular scenario
- Generates scenarios, which are hard to create safely on the road



The simulation runs without any user interaction.



Radar, Camera, Lidar, Manufacturing



RF communication, V2X, GNSS,
Geo-Data management

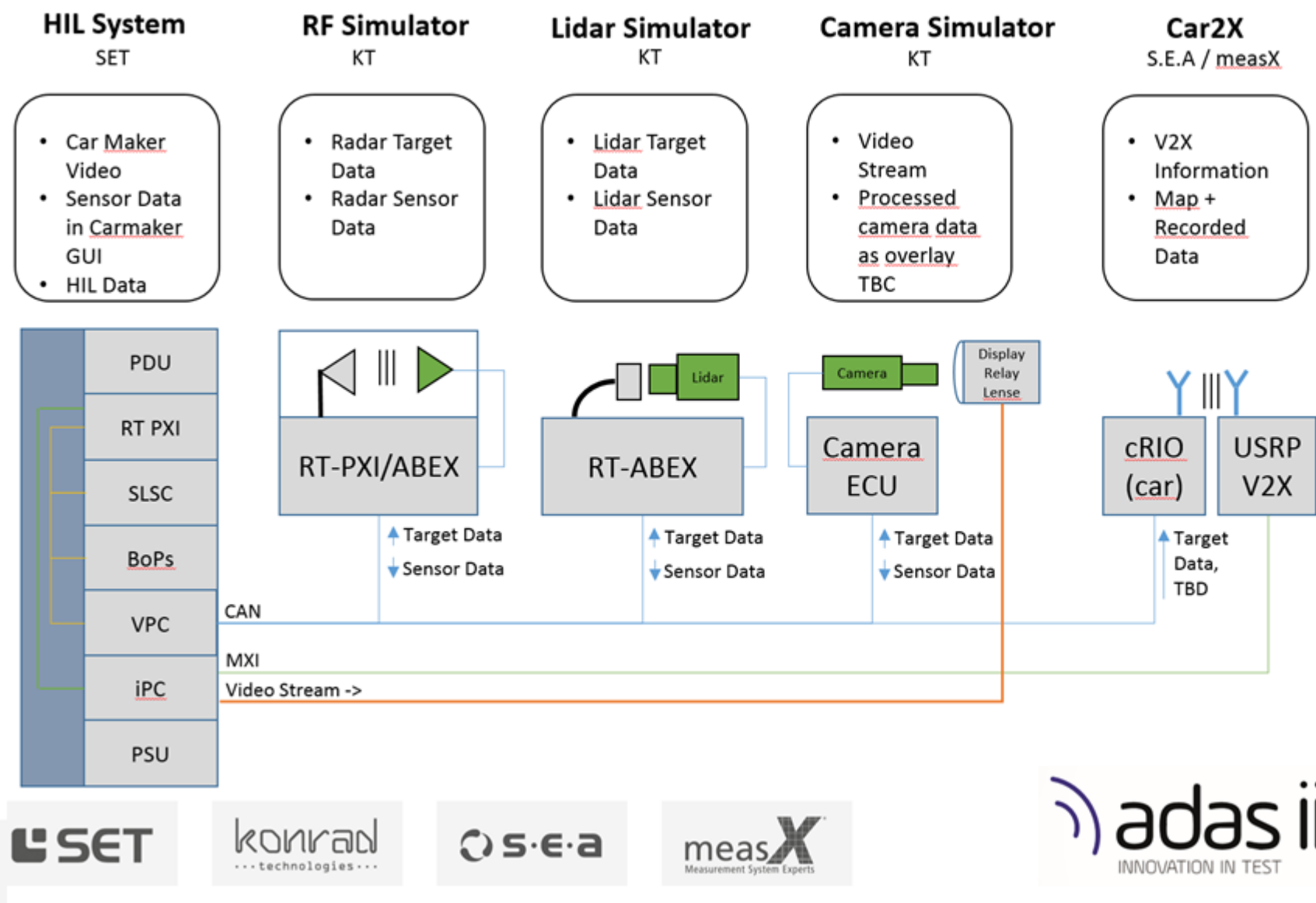


Big data management, data analysis



HIL systems, SLSC, Integration

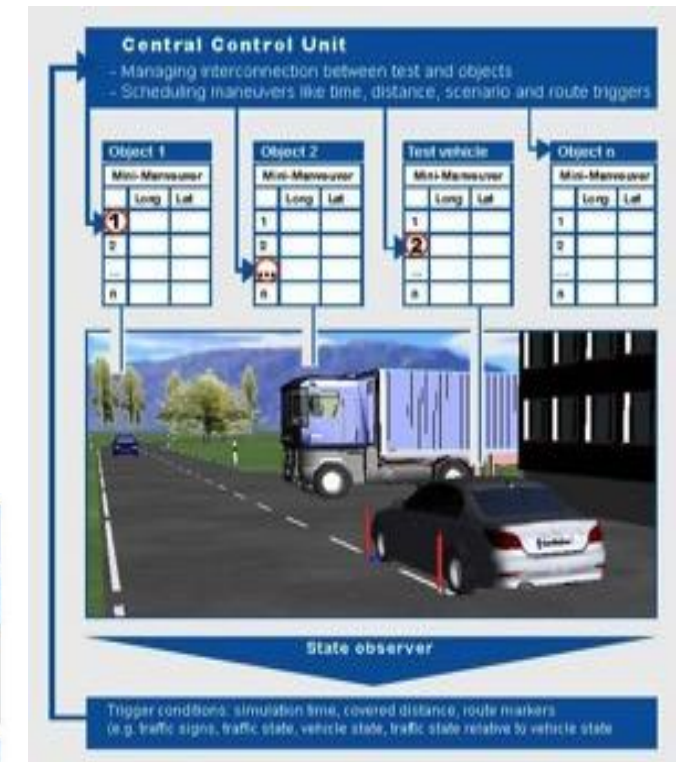
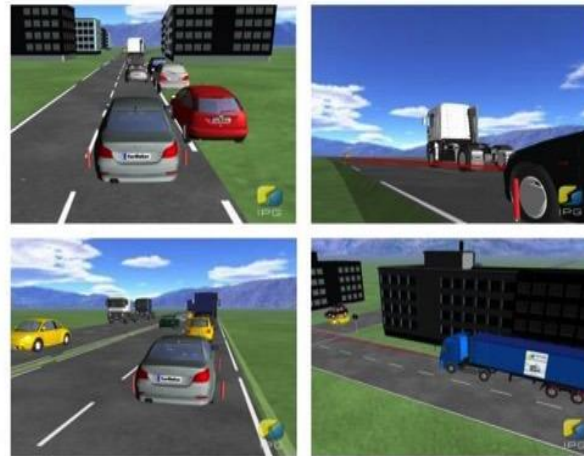
Sensor Fusion



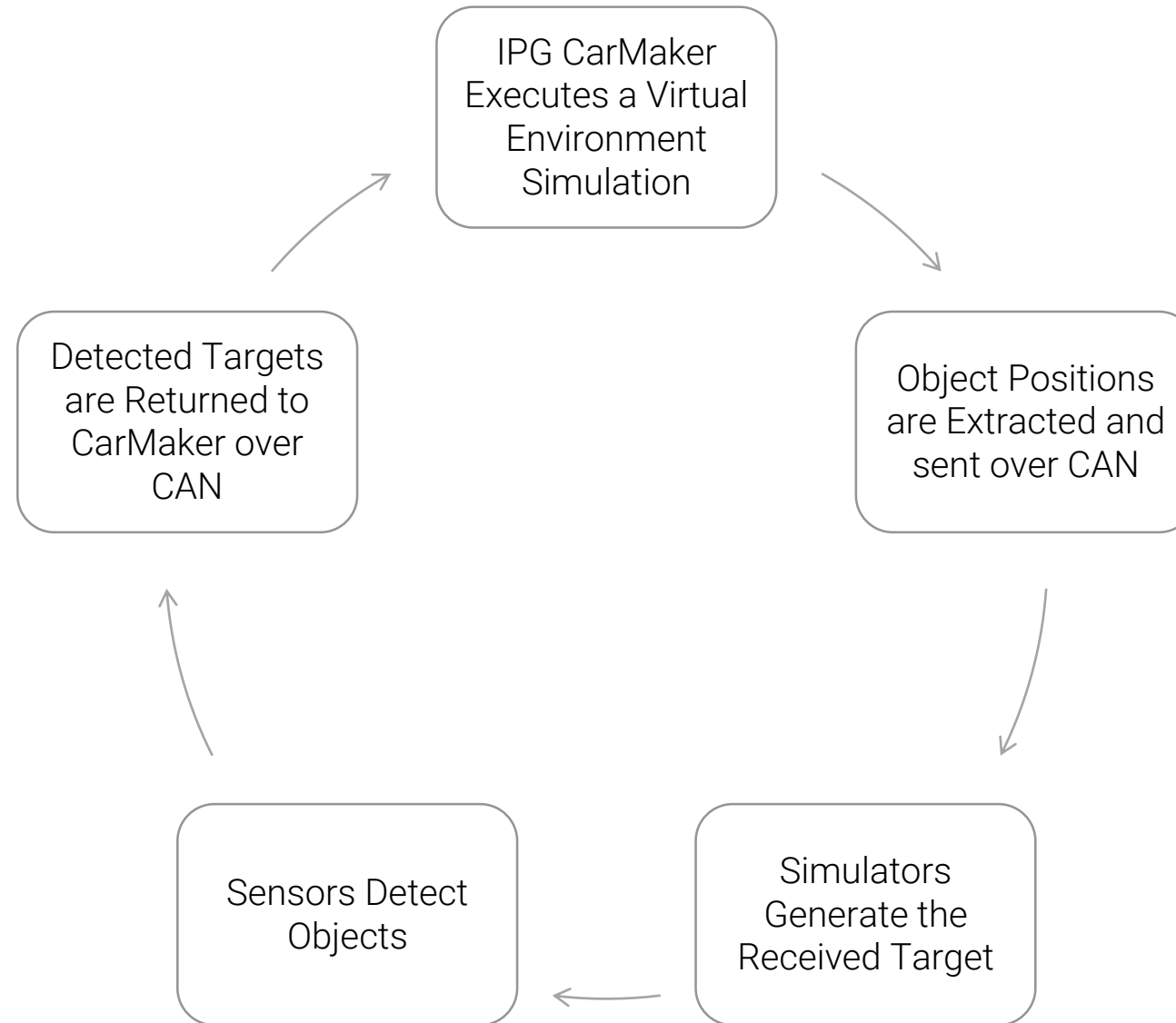
Scenario Generation with IPG CarMaker

IPG CarMaker

- CarMaker used as scenario editor
- CarMaker also simulates the ECU and responds to sensor inputs dynamically
- Sensor failure directly impacts the behavior of the scenario simulation

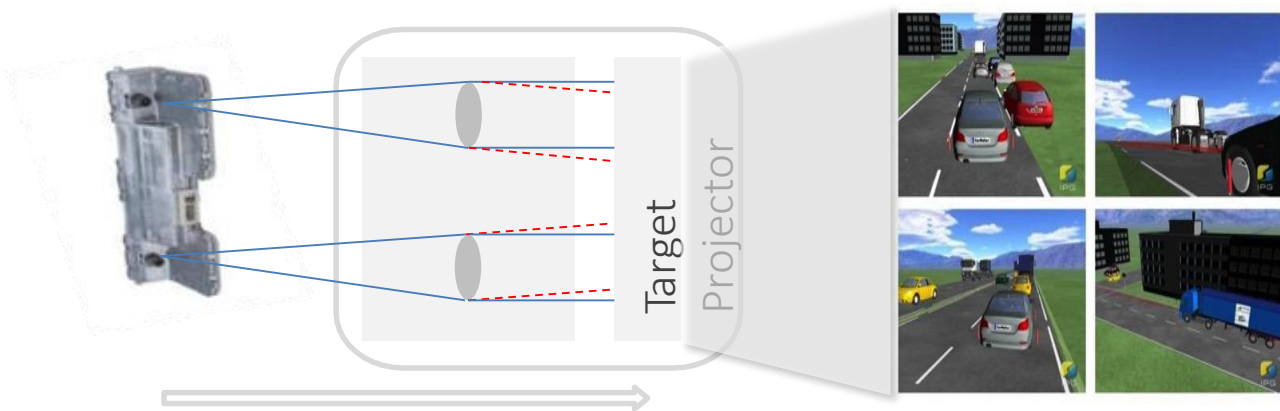


Hardware in the Loop (HIL) Data Flow



Emulation of Camera Targets

- Traditional simulator replays recorded video
- Video is shown on LCD screen
- Dynamic scenarios are not possible



Emulation of Camera Targets

Advantages:

- Optical design inside of target projector transfers the image focus into infinite range
- Camera distance to projector minimized to 5 cm
- System can be used on engineering desk



Emulation of LIDAR Targets

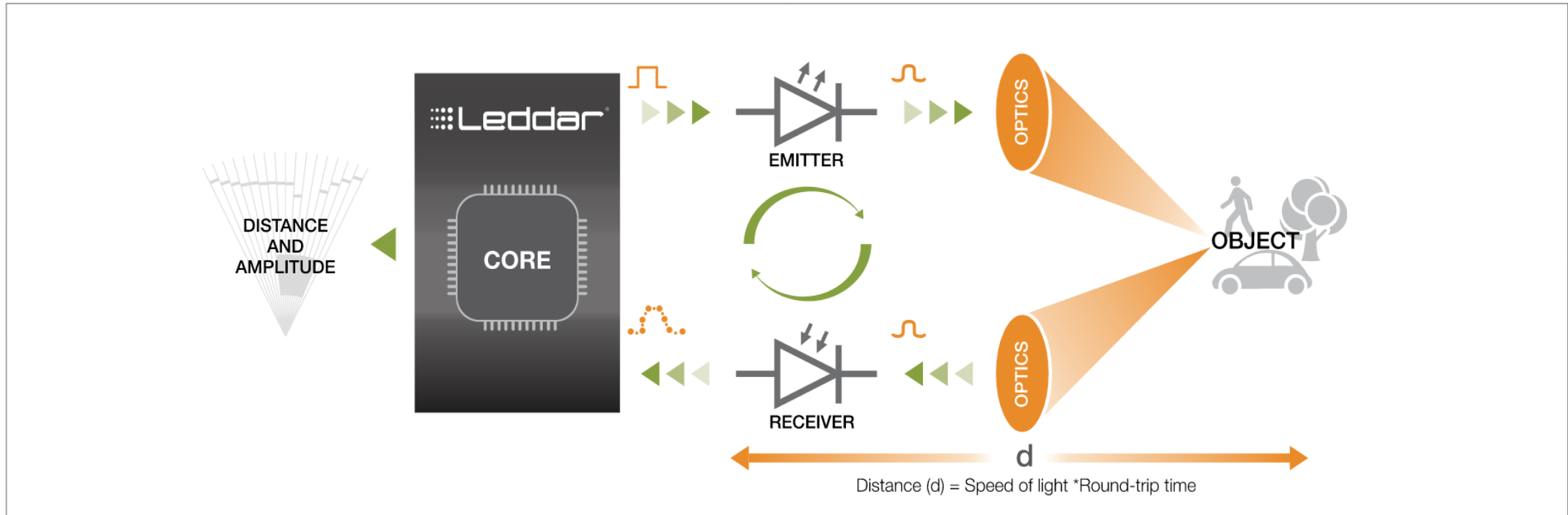
2020 Market Expectation for LIDAR is US \$15 Billion

Dr Rajender Thusu, industry principal for sensors & instruments at industry analyst Frost & Sullivan, commented, "The 3D imaging market is expected to grow from US\$5.71bn in 2015 to US\$15.15bn in 2020, led by the development of autonomous shuttles for large campuses, airports, and basically anywhere there's a need to safely move people and cargo. We expect Velodyne LiDAR's line of sensors to play a key role in this surge in autonomous vehicle development, as the company leads the way in partnerships with key industry drivers, along with the fact that sensors like the new Puck Hi-Res are substantially more sophisticated than competitive offerings, and increasingly accessible to all industry players."

September 21, 2016

Emulation of LIDAR Targets

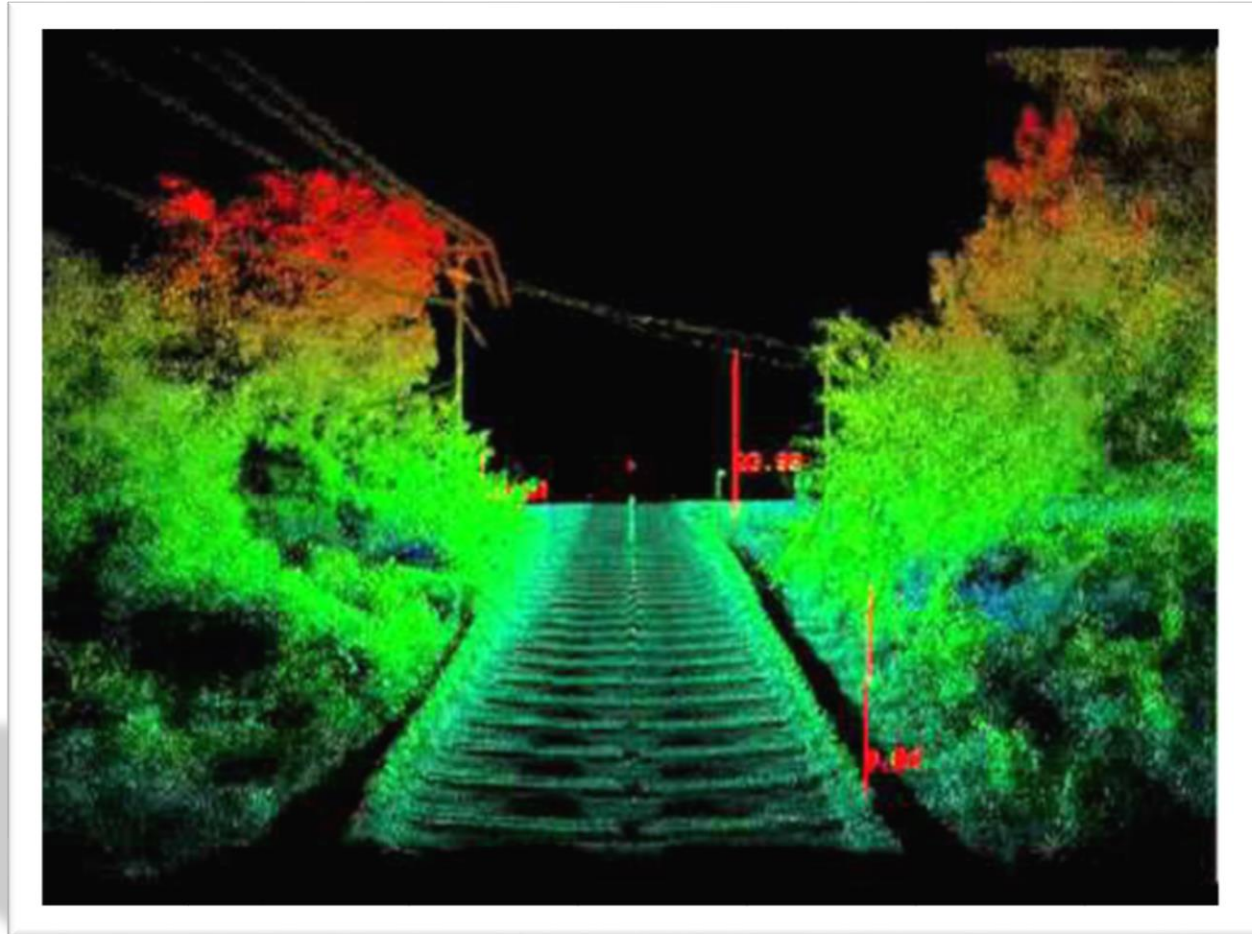
LIDAR working principal



Source: <http://ledartech.com/app/uploads/2016/02/Data-sheet-Leddar-Technology.pdf>

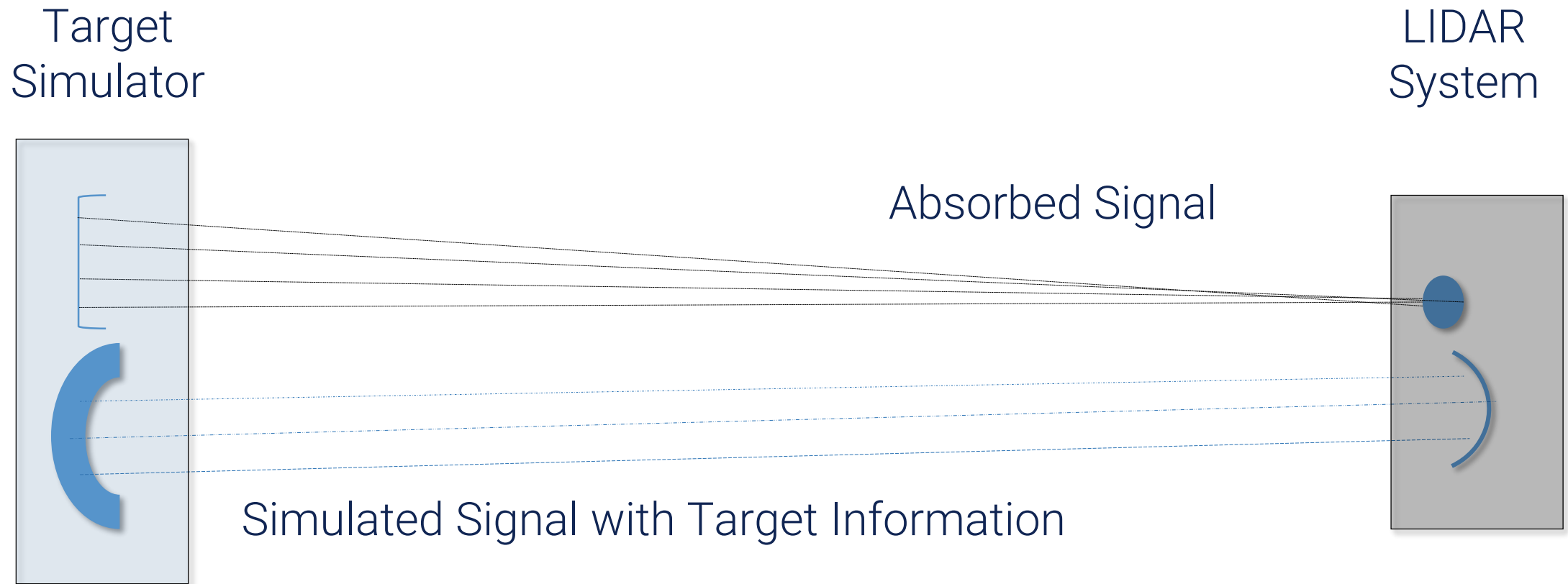
Emulation of LIDAR Targets

Velodyne VLP 16 image



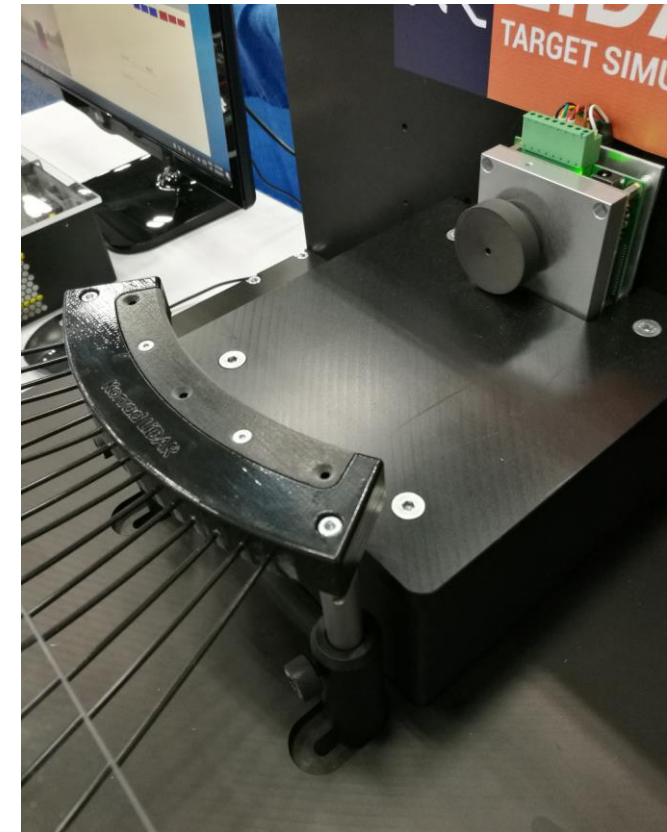
Emulation of LIDAR Targets

LIDAR Target Simulator



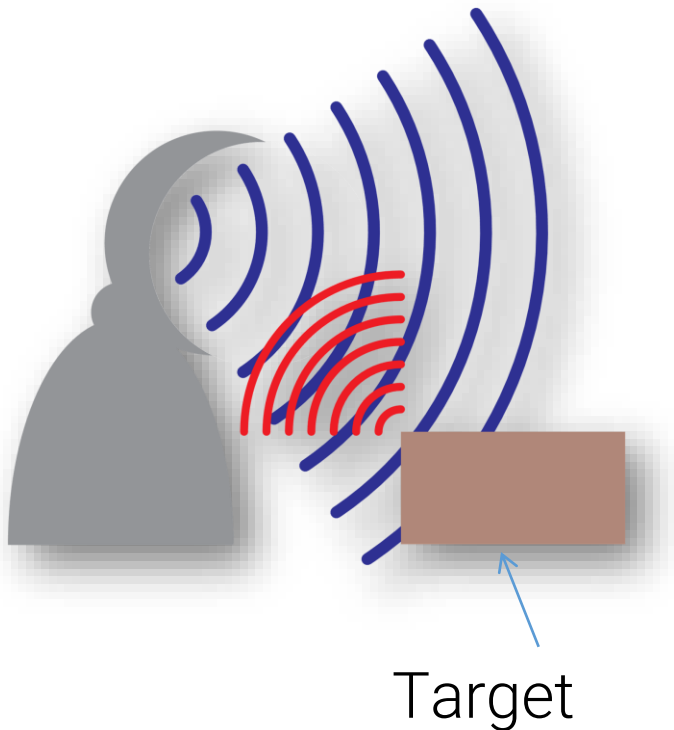
Emulation of LIDAR Targets

- ABex – PXI System
- Optical receiver-transmitter
- 6 channel per slot
- Max. 128 channel per chassis
- Range simulation 10 - 200m
- Light can be fully modulated
- Adjustable light power



Radar Principles of Operation

Transmitter



A radar transceiver emits a signal and listens for an echo (reflection).

The signal will be reflected by the target right back at the transceiver.

From the reflected signal, some parameters about the target can be deducted.

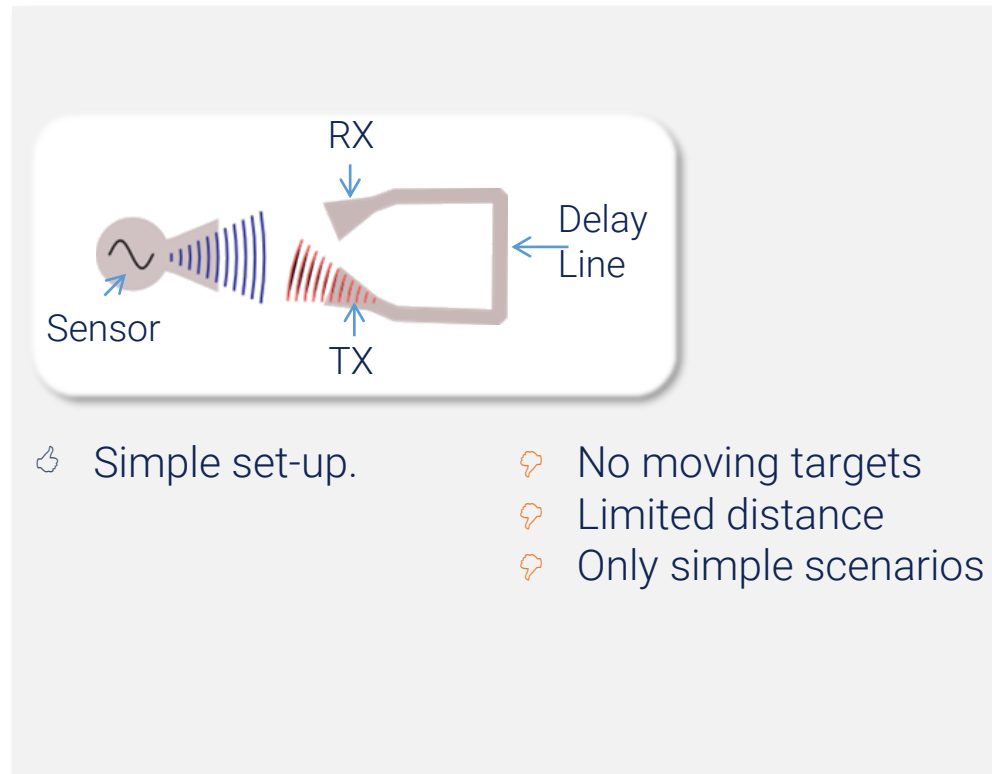
Components of a Radar Sensor

- Similar to Lidar, uses reflections
- Typically uses an antenna array
- Transmits and receives on multiple channels
- Performs processing on a dedicated microcontroller

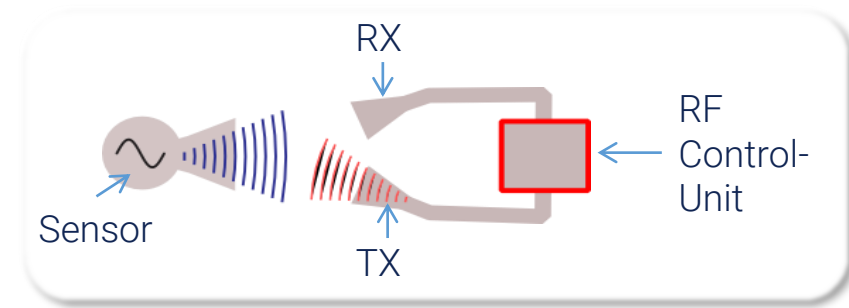


Active vs Passive Radar Target Simulation

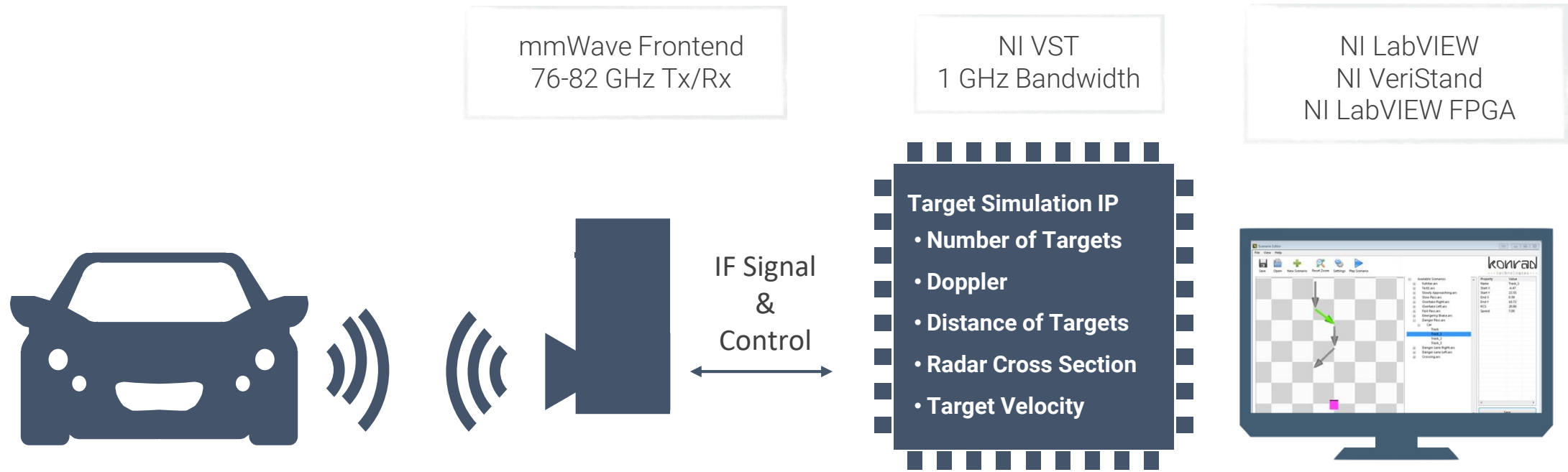
LIDAR Target Simulator



Active Target Simulation



NI Based Active Target Simulation for Radar



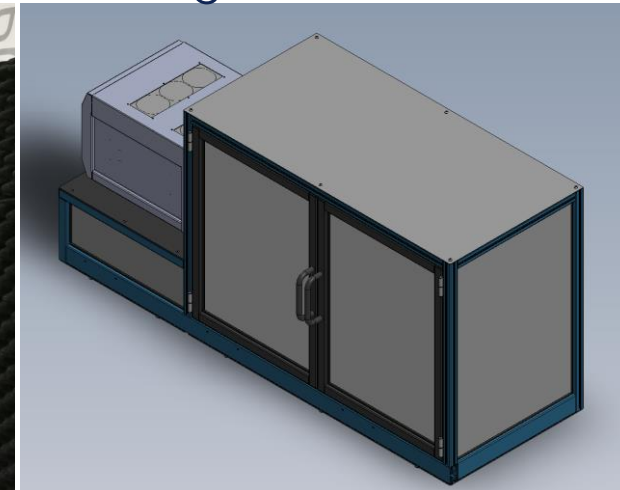
Sensor Fusion with ADAS iiT



Scaling the HIL

- NI provides interface cards for large variety of sensors
- Synchronization between chassis easily achievable
- System is highly compartmentalized
- Each system can be created to support variations of its sensor type

Bench Setup for Radar Target Simulation



Thank you! Questions?

Michael Konrad
CEO Konrad Technologies

m.konrad@konrad-technologies.de
www.konrad-technologies.de

