



# GNSS in Autonomous Vehicles

## MM Vision

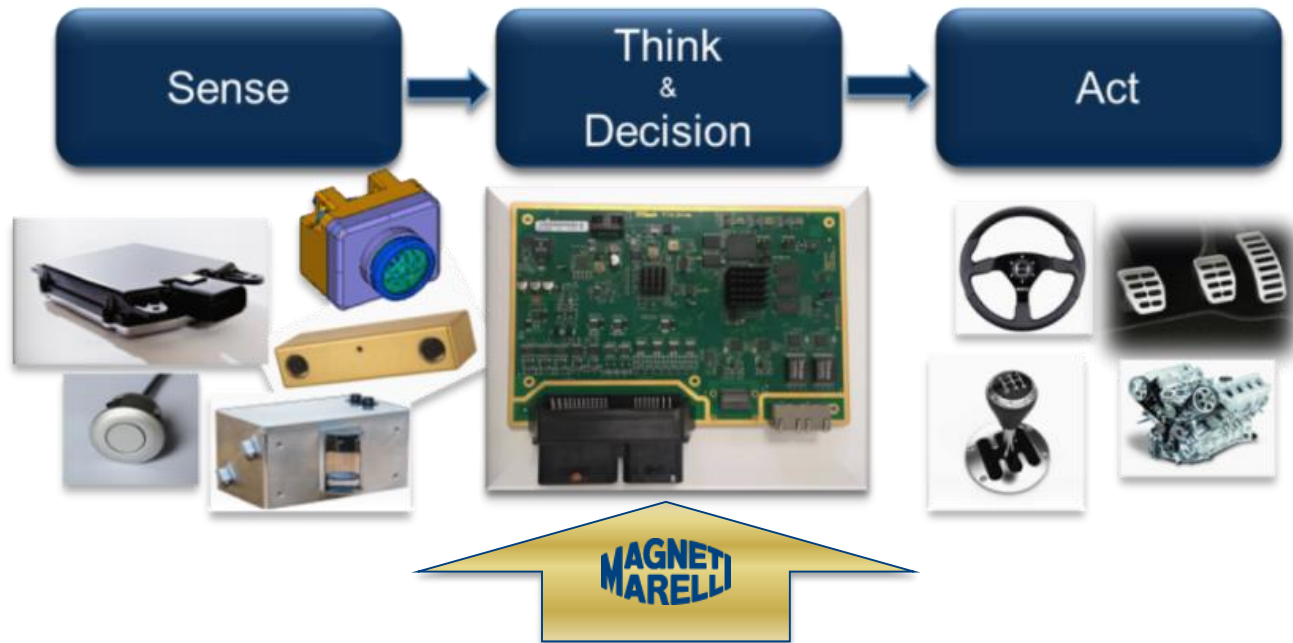
MM Technology Innovation

Automated Driving Technologies (ADT)

Evaldo Bruci

March 2017

Within the *robotic paradigm*



Magneti Marelli chose **Think & Decision** as the key item for study, development, prototyping, product planning

Our framework platform is called:

**Cognitive Fusion Framework (CFF)**

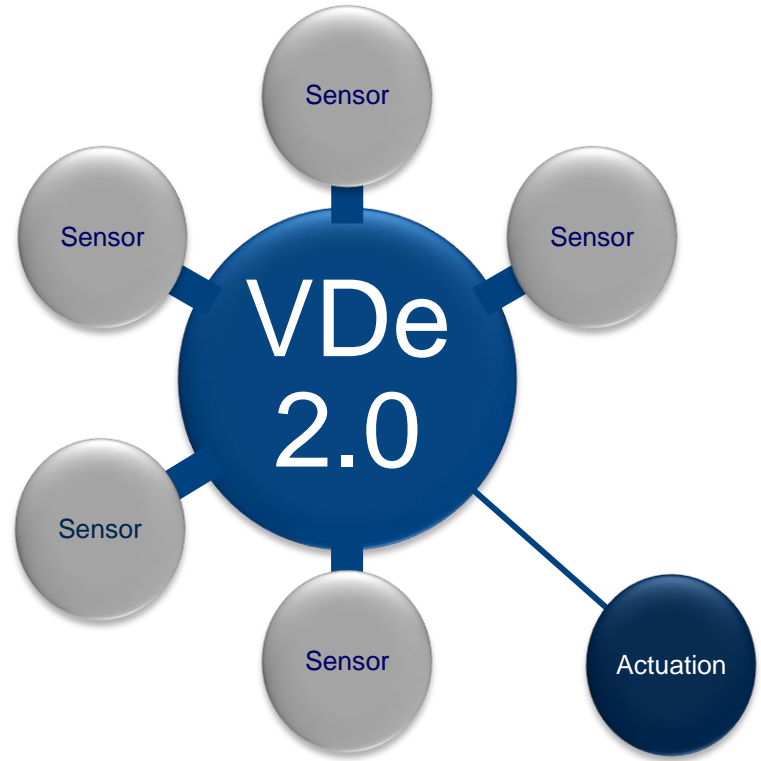
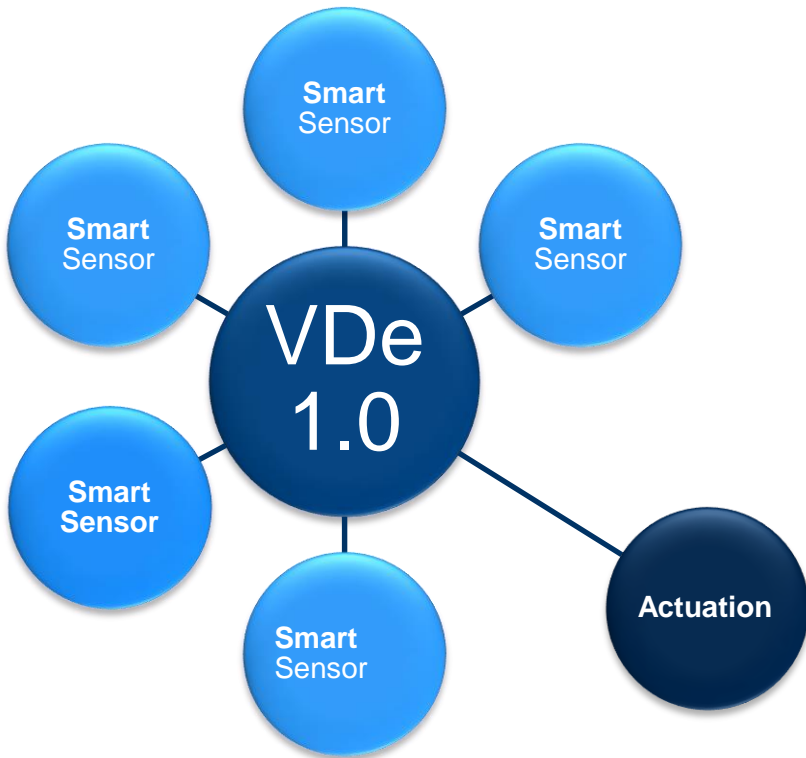
# Automated Driving: Architecture



**Distributed**

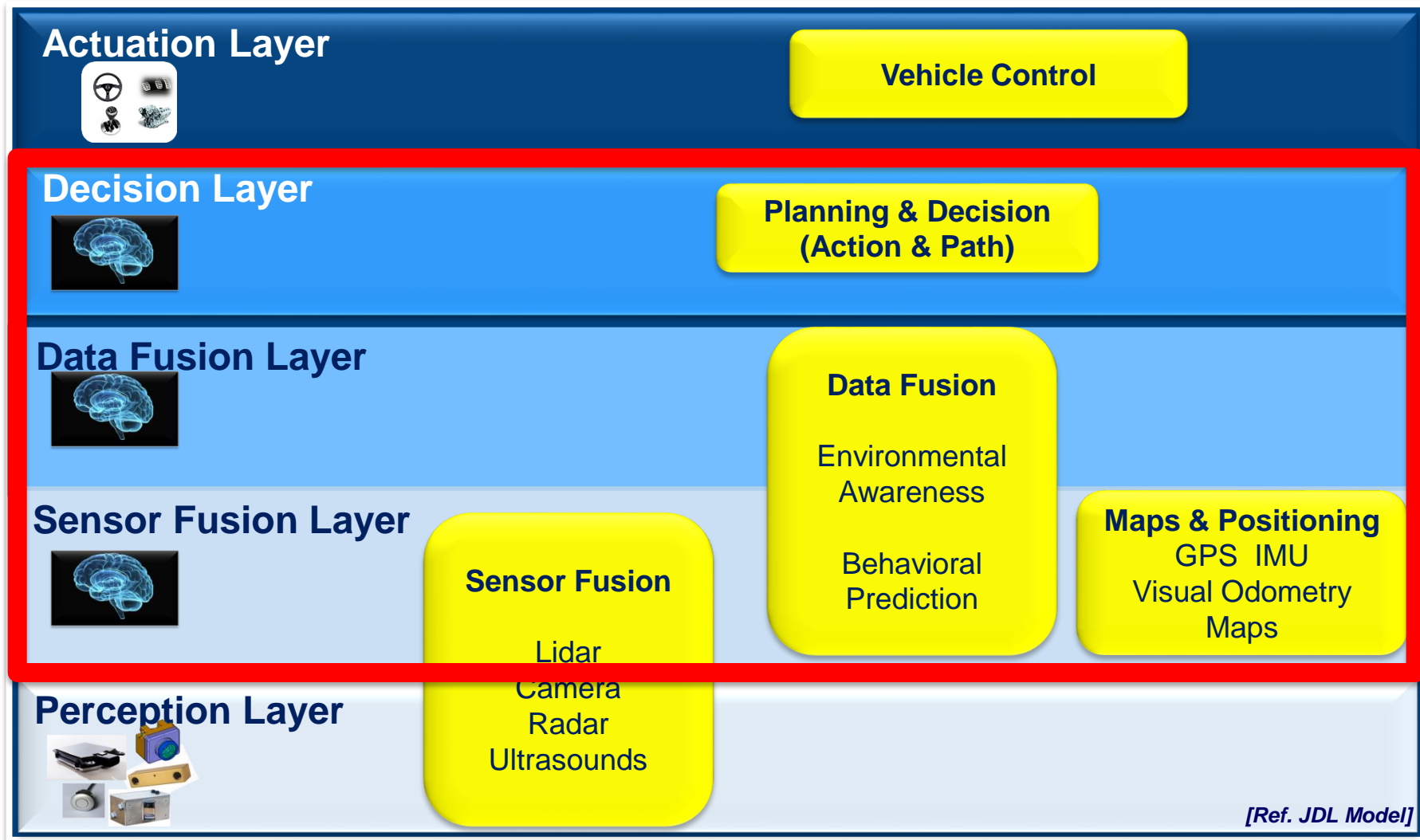
**Mixed**

**Centralized**

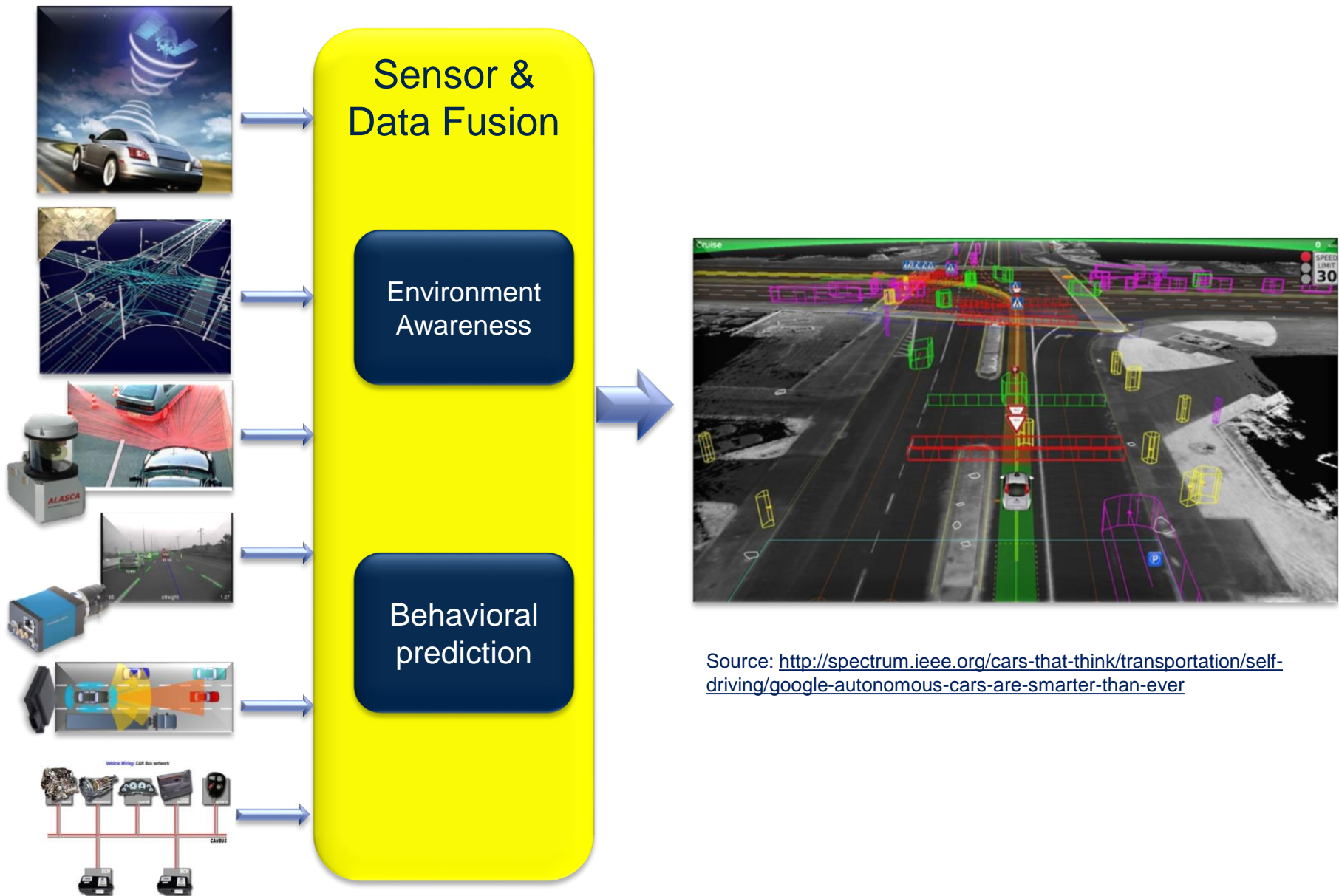


# From perception to movement

## Cognitive Fusion Framework Perimeter



# Fusion to create an environmental model

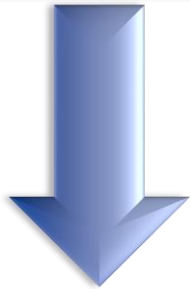
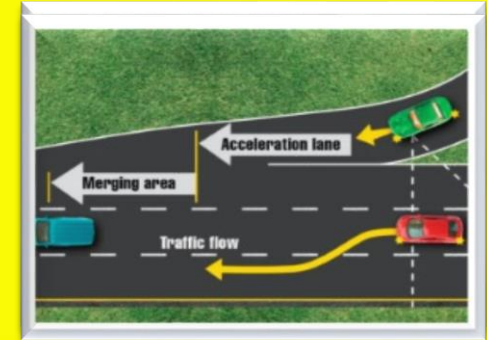


Source: <http://spectrum.ieee.org/cars-that-think/transportation/self-driving/google-autonomous-cars-are-smarter-than-ever>

## Action Planning



Keywords  
Risk Assessment  
Deep Neural Networks



Safety

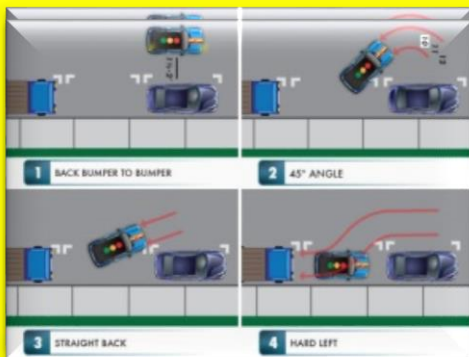


Fuel Efficiency

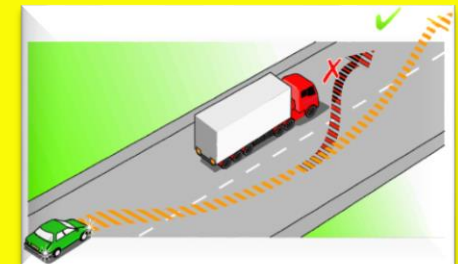


Comfort

## Path Planning



Keywords  
Trajectory estimate



# Localize with high precision

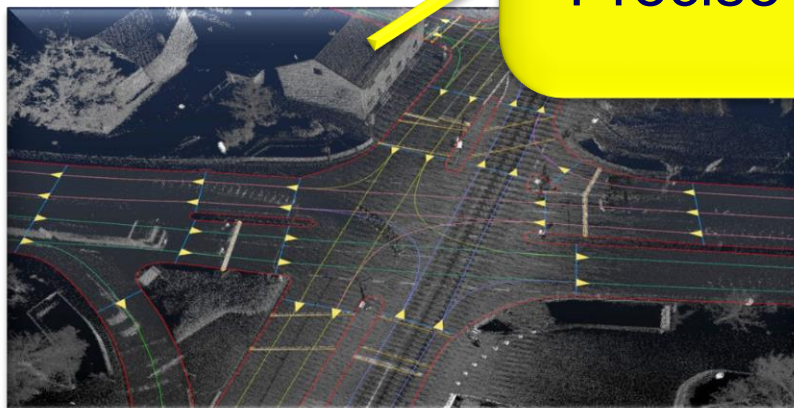


Precise GNSS

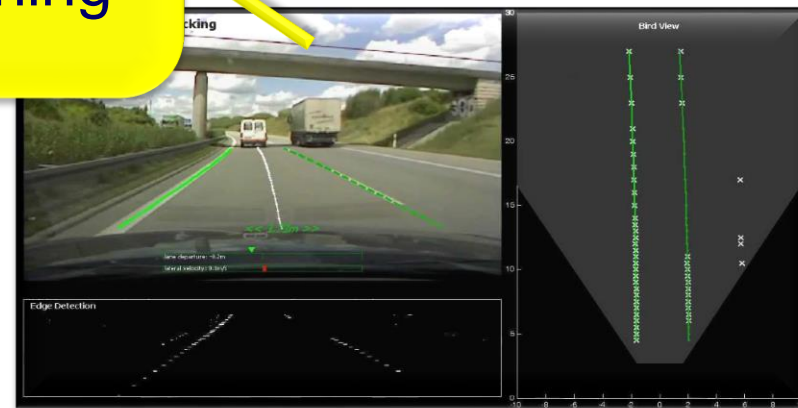


Precise Inertial sensors

Map Manager  
&  
Precise Positioning



HD Maps



Lane detection/visual map matching

## Highway use case



## Automatic Valet Parking use case

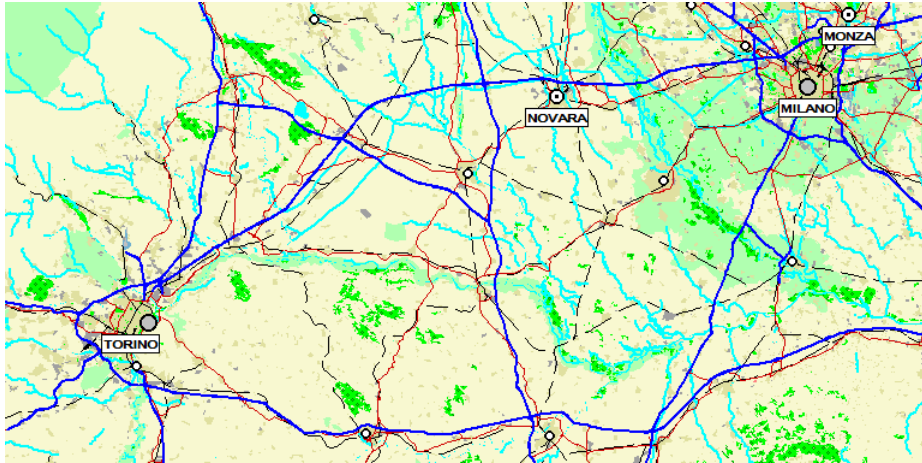




## Urban use case



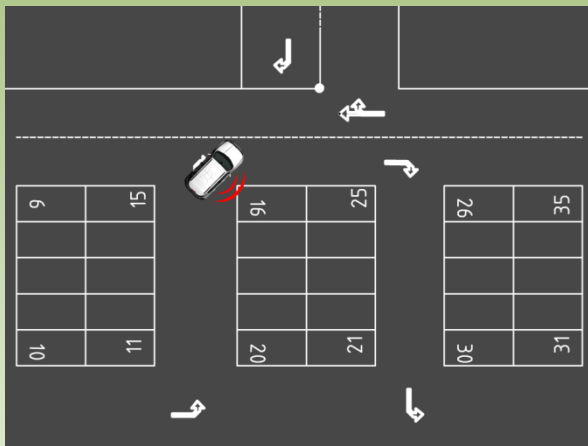
## Long distance Highway use case



It must work in fusion with the whole system.  
But in failure mode it must be able to work alone.

## Positioning+map must:

**Guarantee navigation among the parking spaces in automatic valet parking**



**Guarantee lane keeping in motorway, highway and city boulevards**



## Target accuracy:

- Positioning accuracy :
  - 20 cm
- Cartography accuracy:
  - 20 cm max error on node coordinates

## Strategy for achievement:

- Positioning accuracy :
  - Accurate sensors
  - Well designed sensor fusion
  - GNSS Ultra tight integration
  - GNSS PPP – RTK
  - Visual Map Matching
- Cartography:
  - Work on requirements with suppliers

Strategy	Pro's	Con's
<b>PPP</b>	<ul style="list-style-type: none"><li>• Function suitable for automotive</li></ul>	<ul style="list-style-type: none"><li>• Subscription price not yet at automotive level</li><li>• Receiver price not yet at automotive level</li></ul>
<b>RTK</b>		<ul style="list-style-type: none"><li>• Require additional communication channel</li><li>• Low-zero price available, but not world wide spread</li><li>• Receiver price not yet at automotive level</li></ul>



**COST IS THE BLOCKING FACTOR**

- Reasonable autonomous car price 30-50 Keuro
- The cost of a GNSS with phase detection capability is still between 1 and 10 KEuro

**Automotive cost is the key issue for GNSS success in autonomous driving**

- Receivers
- Services

## **The strategy is cooperation with suppliers:**

- GNSS engine suppliers
- PPP – RTK corrections providers

## **Points to be exploited :**

- Accurate definition of the products specification's
- Advantage of automotive level mass production

- Highly promising in terms of GNSS reliability/Integrity
- Accuracy increase is expected
- **No added cost in the final product**

How can Magneti Marelli perform an active role?



An autonomous vehicle must have Cameras/Laser scanners  
**No added cost in the final product**

How can Magneti Marelli perform an active role?







Thank you

March 2017