



# Autonomous Driving: challenges for Geographical Information Scientists and Practitioner

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# Autonomous Driving



- From a technological stand point, vehicles able to drive without human intervention for the most of the time are just around the corner.



# Tesla Autopilot on Model S



- *The Model S use its unique combination of cameras, radar, ultrasonic sensors and data to automatically steer down the highway, change lanes, and adjust speed in response to traffic.*

*Once you've arrived at your destination, Model S scans for a parking space and parallel parks on your command.*



# Benefits of AD

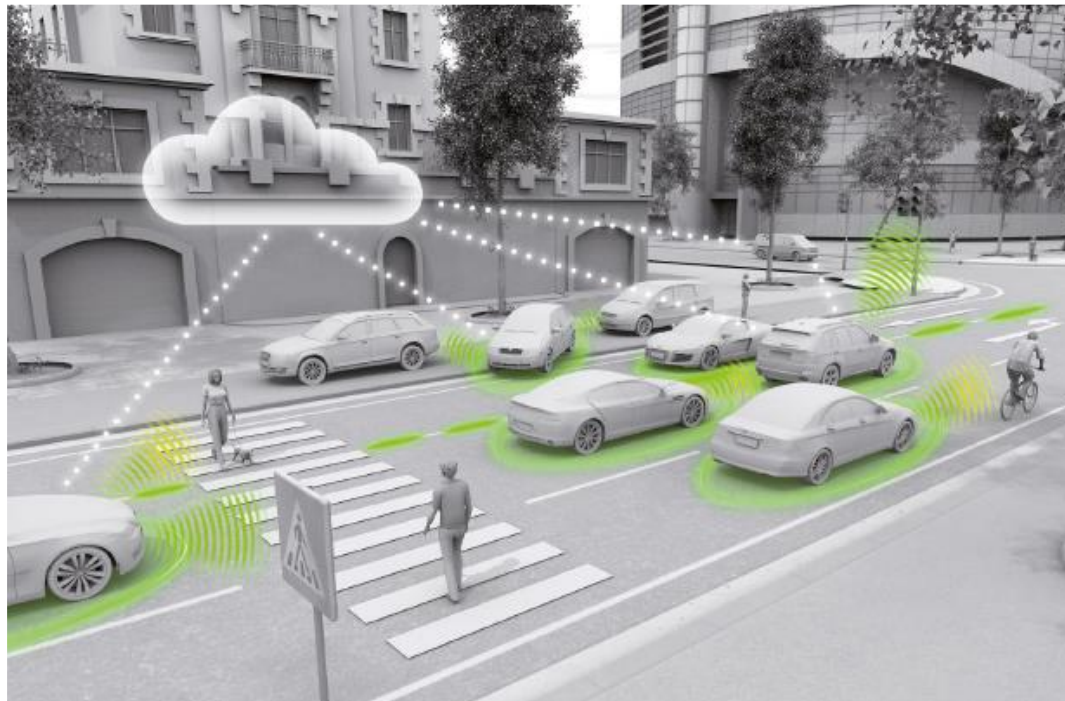


- Avoid incidents (95% caused by human driver errors)
- Reduced traffic congestion, due to reduced need for safety gaps and the ability to better manage traffic flow.
- Improved ecologic footprint
- Reduction in labor costs if human driver isn't required.
- Relief of vehicle occupants from driving and navigation stress.
- Removal of constraints on occupants' state – in an autonomous car, it would not matter if the occupants were under age, over age, unlicensed, blind, distracted, intoxicated, or otherwise impaired.
- Increased time in daily leisure activities or work productivity with the replacement of commuting hours.
- ... (*many many others*)

So? Is it everything done?

# Requirements for AD

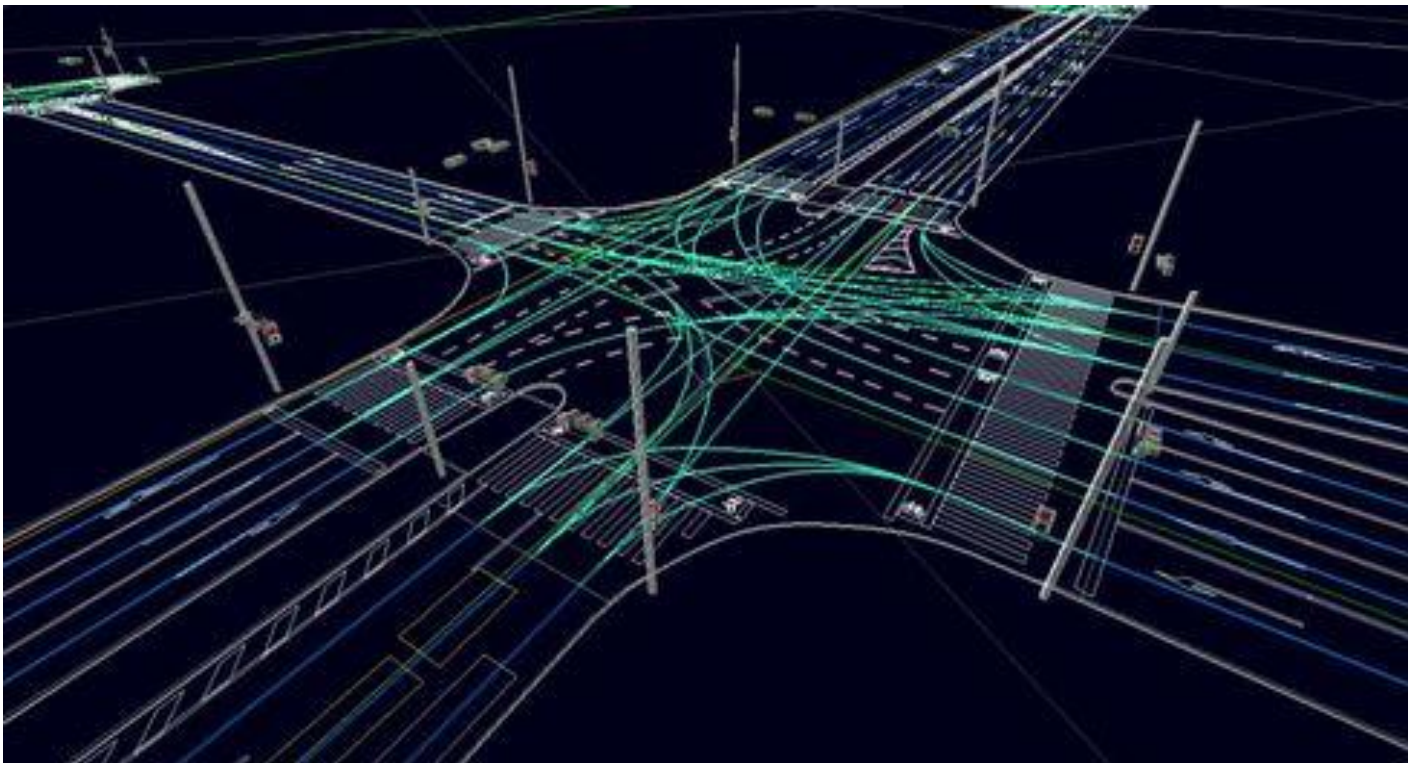
- Advanced sensor technology (computer vision, radar, lidar, ultrasonic, etc.)
- More accurate Maps
- More precise localization
- Advanced Machine Learning solution



# Maps for AD



- We need maps with a Detailed Lane Model



# Geo-Spatial Challenges



- Advanced, certified and up-to-date maps
  - Maps become a key "sensor" for the vehicle.
  - They must have new quality attributes
  - Map content will be auto-generated by means of data mining and aggregation over massive spatio-temporal datasets

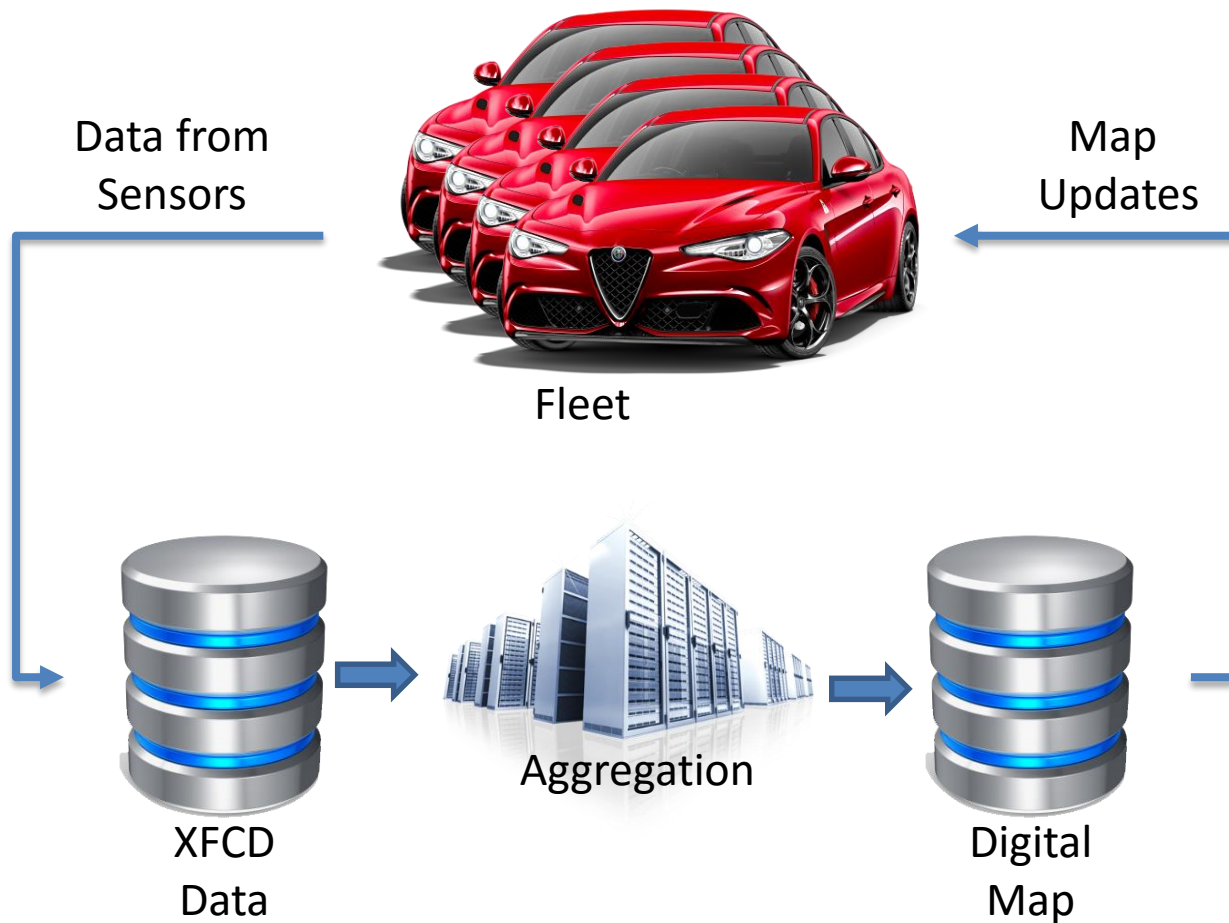


# FCD and XFCD



- Currently, the on-board sensors are generating about 20GB/h of new data, per vehicle.
- If we could collect a fraction of this data on a shared back-end, we would be able to derive new knowledge and novel exciting services.
- Each vehicle in the future will be part of a sensor network
- On a EU-scale, if we could collect just FCD, we would get about 50GB per minute → about 30 Pb per year
  - If we would collect Extended FCD, we would need something bigger than the CERN LHC Data Center, by two orders of magnitude!

# The Loop for Map Updates



# Wrapping up



- How can we collect and store such an amount of data?
- How can we adapt spatio-temporal data mining algorithms to deal with it?
- How can we represent and broadcast new spatial knowledge to all the vehicles?
- How can we measure the goodness and newness of the the information on the map?

# Thank you

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