Applying AI to Mapping

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TRI: Who We Are

Our mission is to improve the quality of human life through advances in artificial intelligence, automated driving, and robotics.

We are dedicated to creating a world where everyone, regardless of age or ability, can work in harmony with technology to enjoy a better life. Through innovations in AI, we will develop a car incapable of causing a crash, regardless of the actions of the driver. We will also develop technology for vehicles and robots to help people enjoy new levels of independence and mobility in their daily lives.

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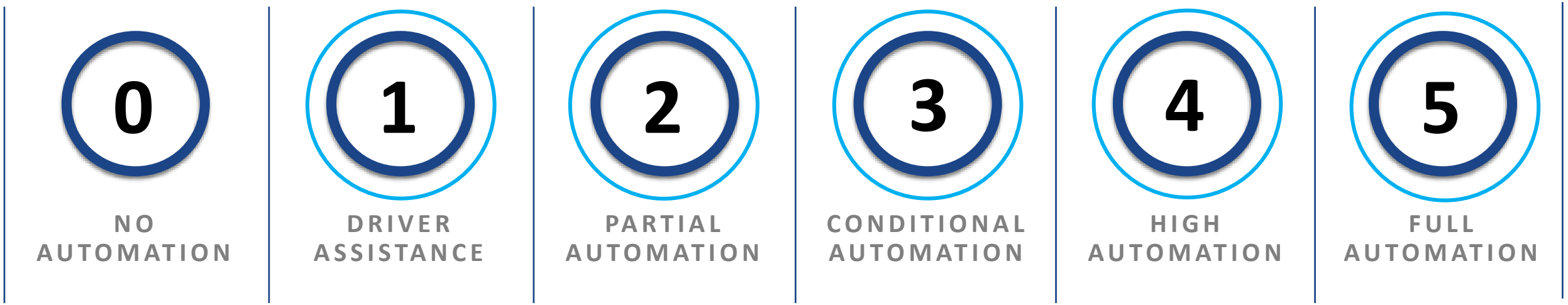
SAE Levels of Automation

SAE INTERNATIONAL™

J3016

Level 1	One degree of freedom is controlled, e.g., longitudinal Adaptive Cruise Control
Levels 4/5	Human is always a passenger; the only distinction between 4 and 5 is operational domain (i.e., geofenced vs. unrestricted)



Level 2	Readiness for hand-off requires constant vigilance from driver that may not be sustainable over time
Level 3	Difficult for vehicle to ensure driver has sufficient warning to re-engage in time for hand-off

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Automated Driving Approach: One System, Two Modes

Driver always engaged, but vehicle monitors and intervenes to help prevent collisions

Fully autonomous driving system engaged at all times

Builds on similar hardware and software development as fully-autonomous Chauffeur

Staged commercial release, likely beginning with shared mobility fleets

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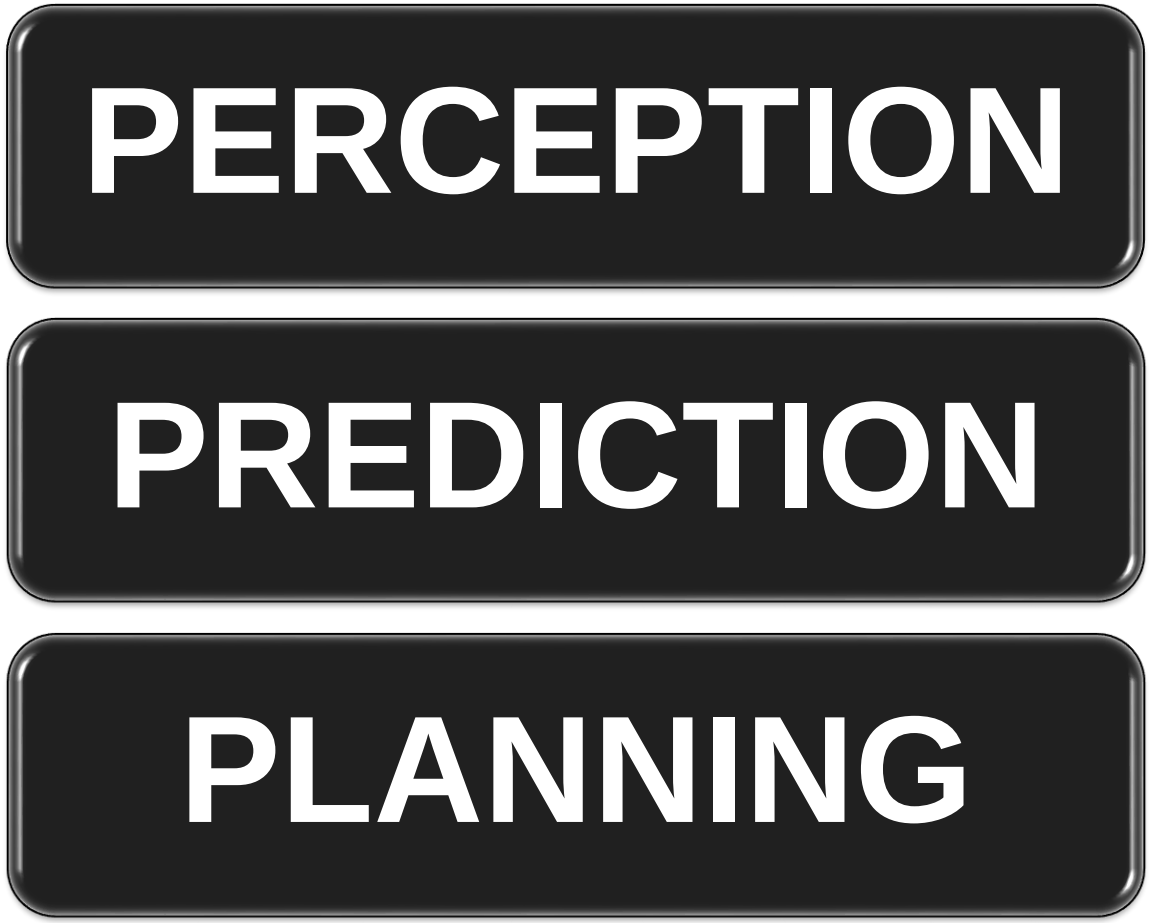
Core Elements of Automated Vehicles



Interprets what the vehicle “sees”

Anticipates what others might do

Decides an action the vehicle will take

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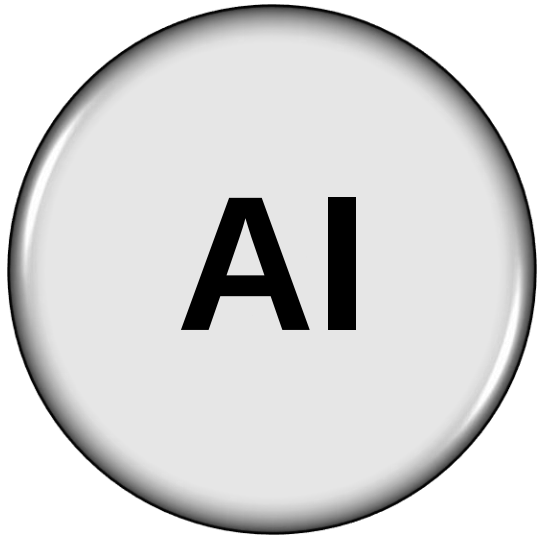
Core Elements of Automated Vehicles

PERCEPTION

PREDICTION

PLANNING



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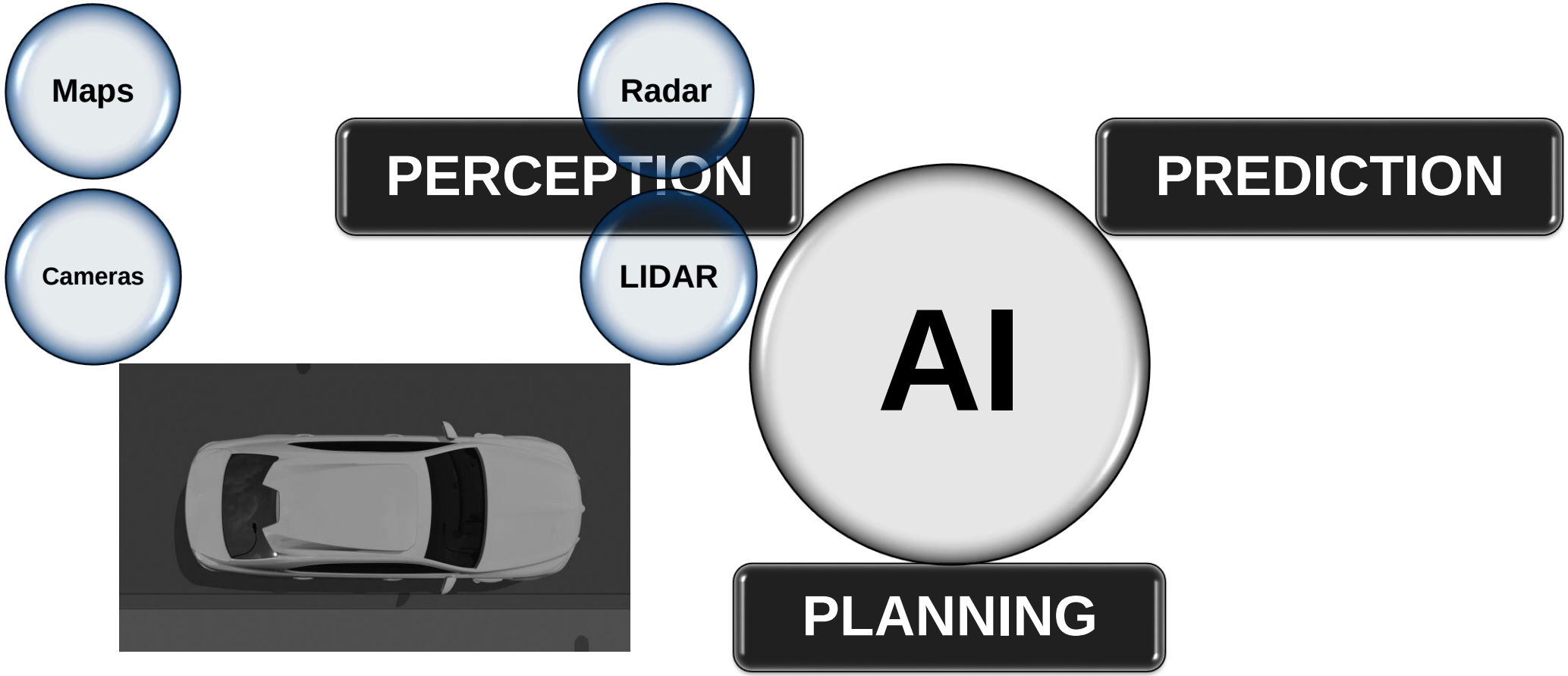
Core Elements of Automated Vehicles



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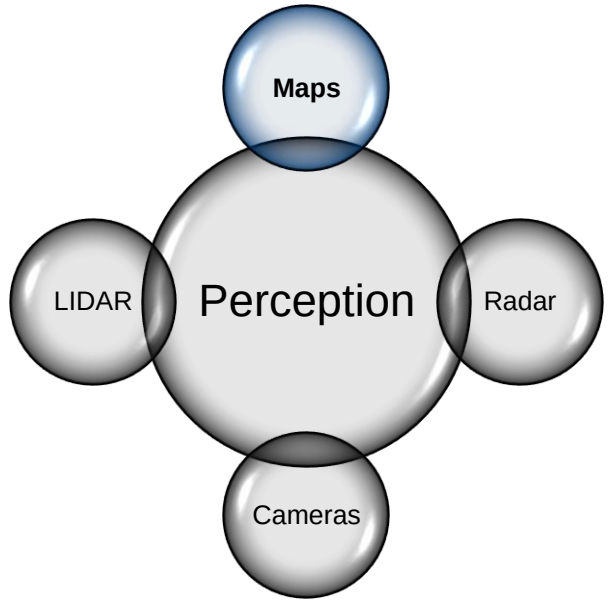
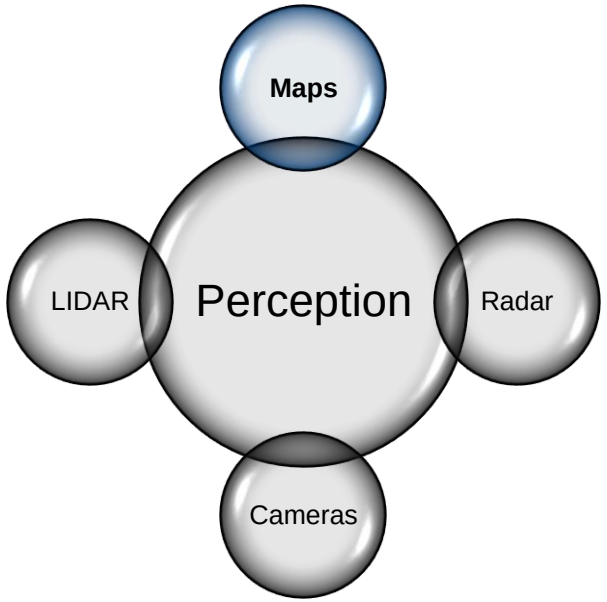
The Use of Maps

- Your navigation system operates from onboard maps
- PROBLEM: Roads are always under construction…Most maps are outdated the moment they're created
- Automated vehicles use more sophisticated maps plus localization to *simplify perception*
- BUT…they have similar map issues



The Use of Maps



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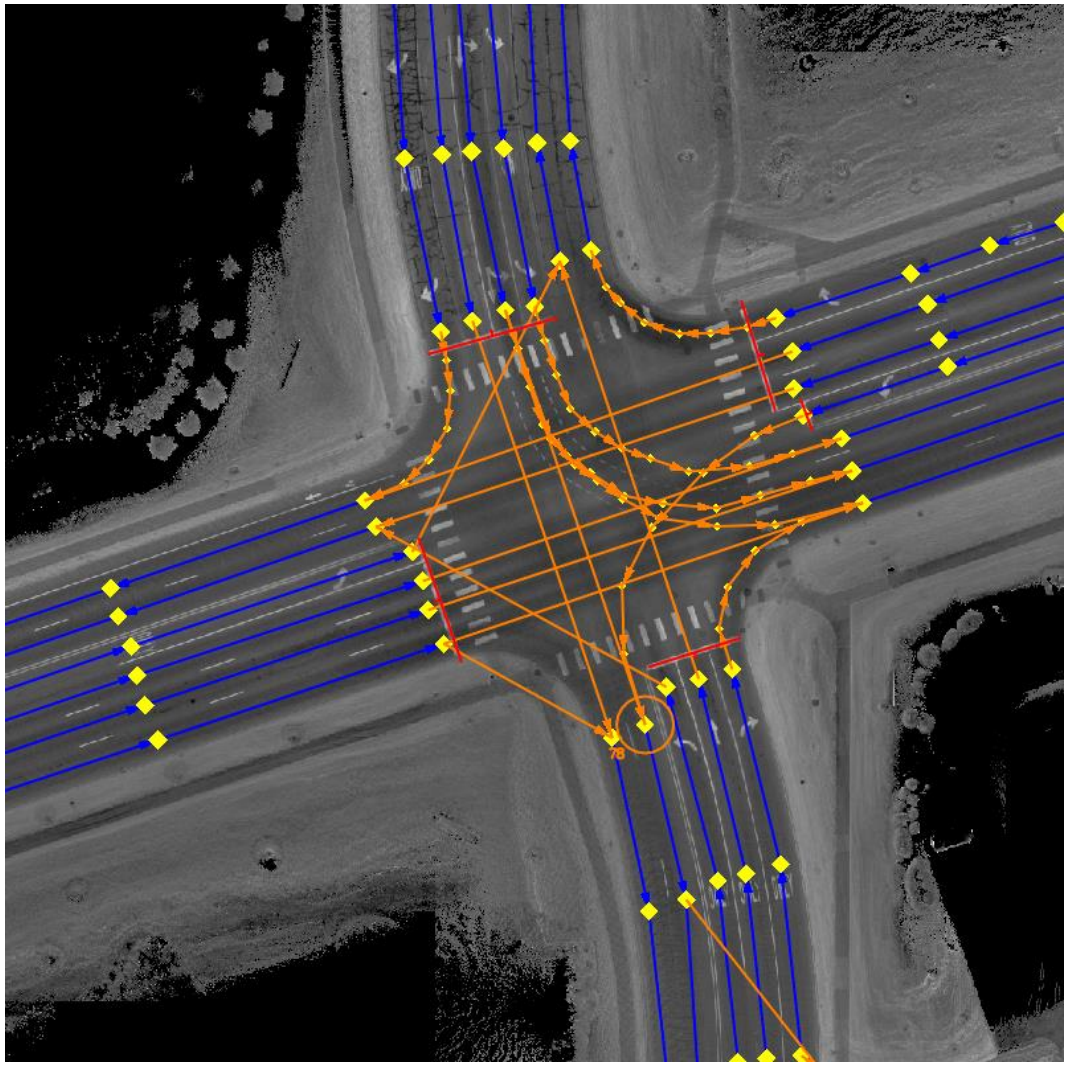
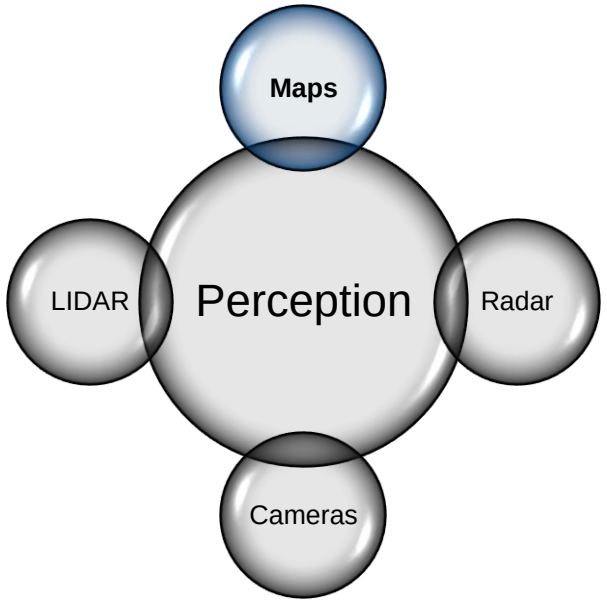


- **Lane center/adjacency**
- **Stop lines**
- **Intersection connectivity**



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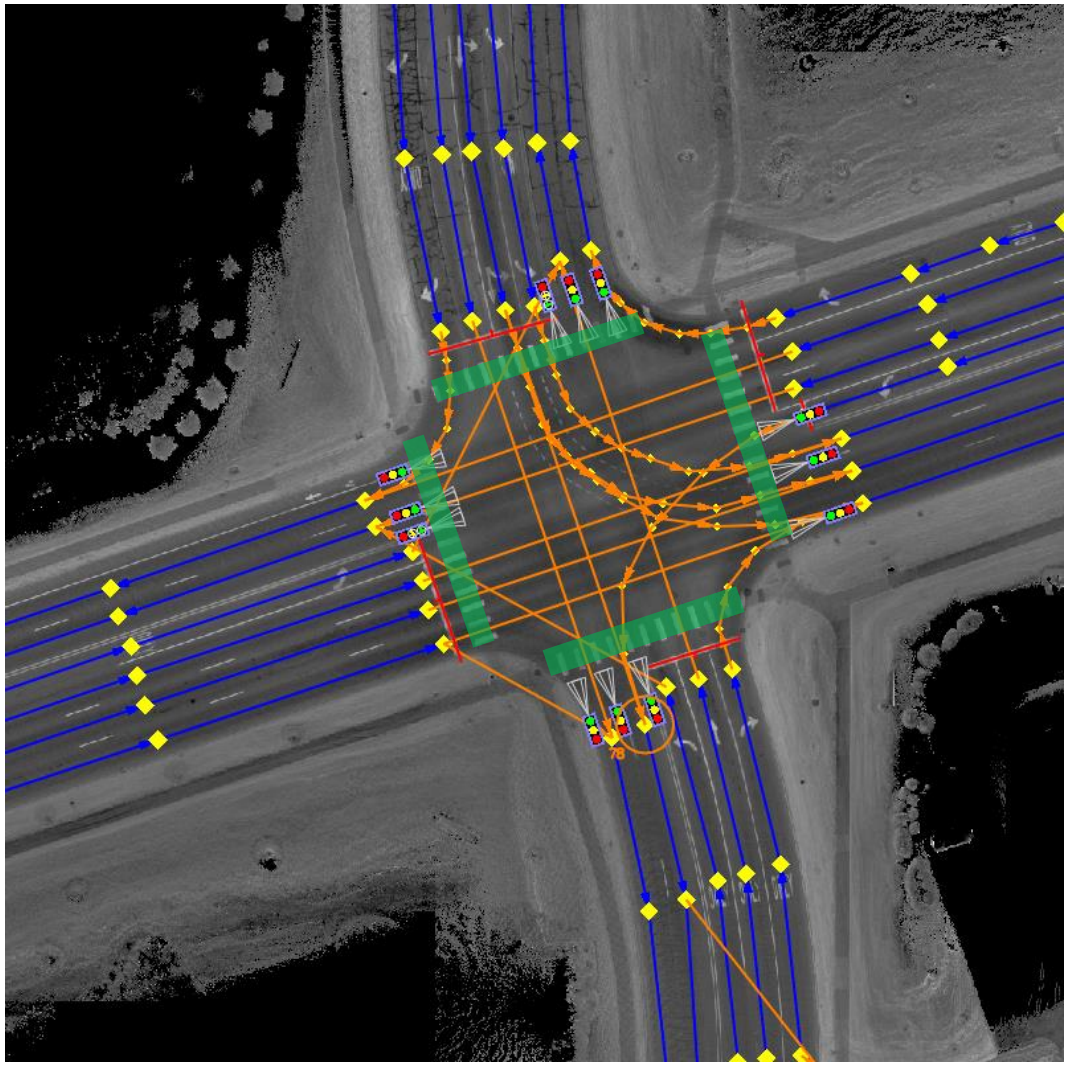
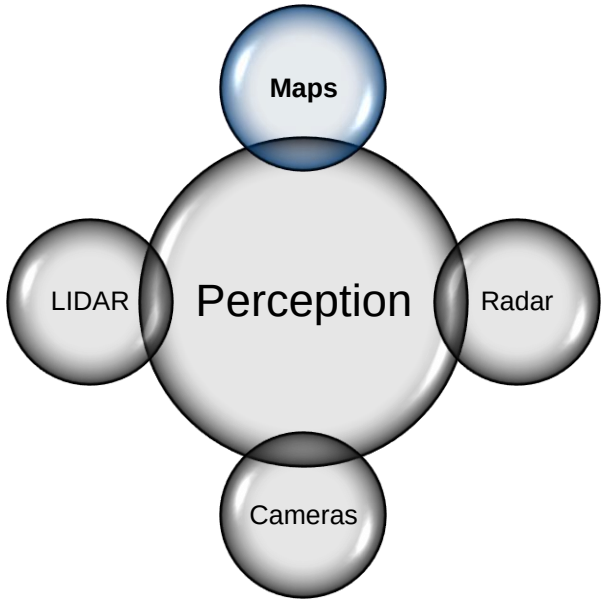


- Lane center/adjacency
- Stop lines
- Intersection connectivity
- Traffic lights
- Crosswalks



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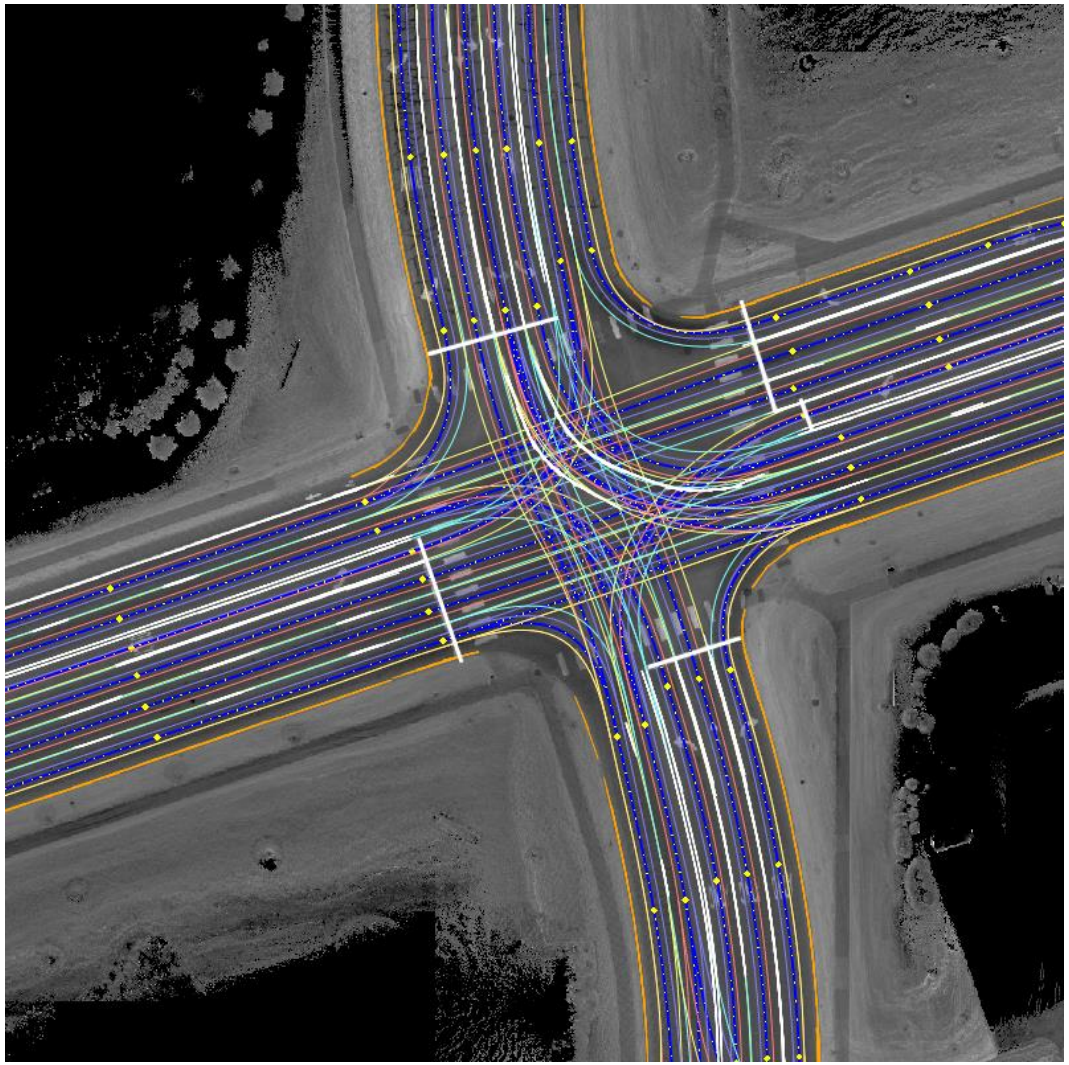
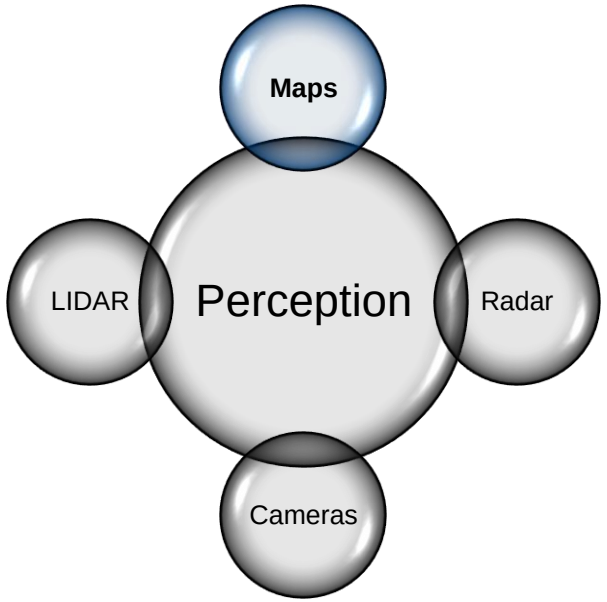
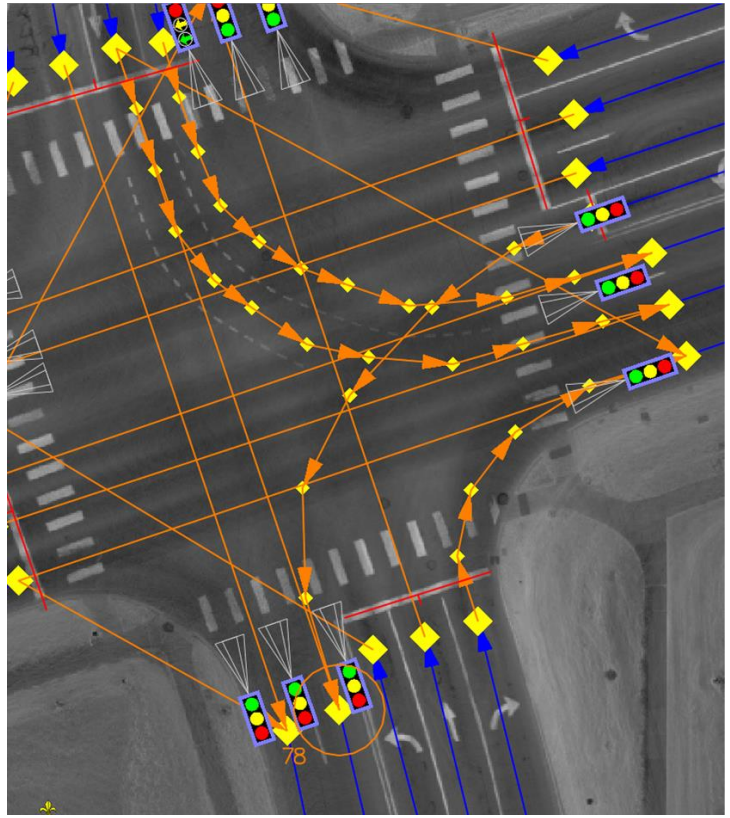


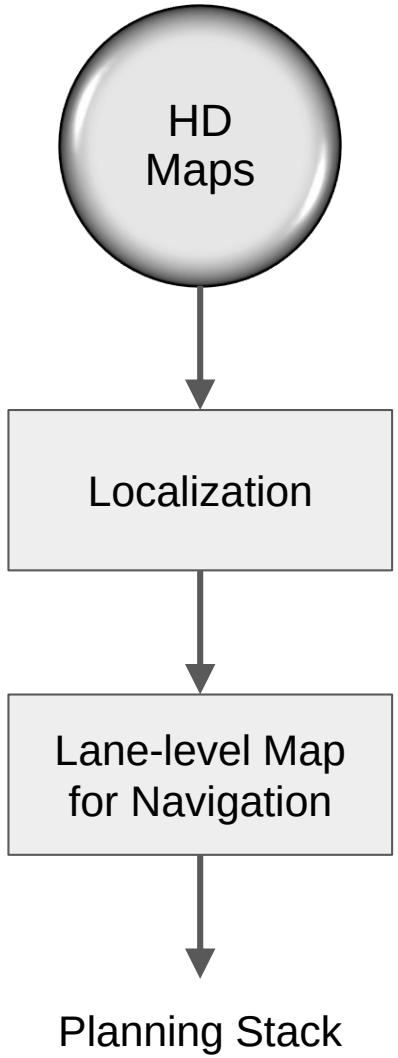
- **Lane center/adjacency**
- **Stop lines**
- **Intersection connectivity**
- **Traffic lights**
- **Crosswalks**
- **Offline trajectory optimization**
- ***Etc.***



Common Approach to Level 4/5

What do we do with HD maps?





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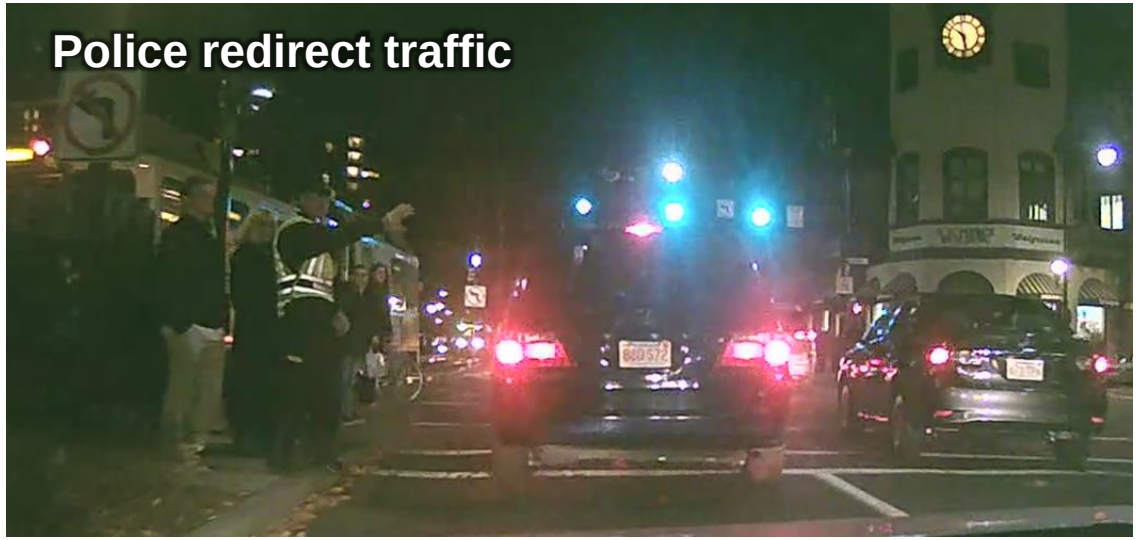
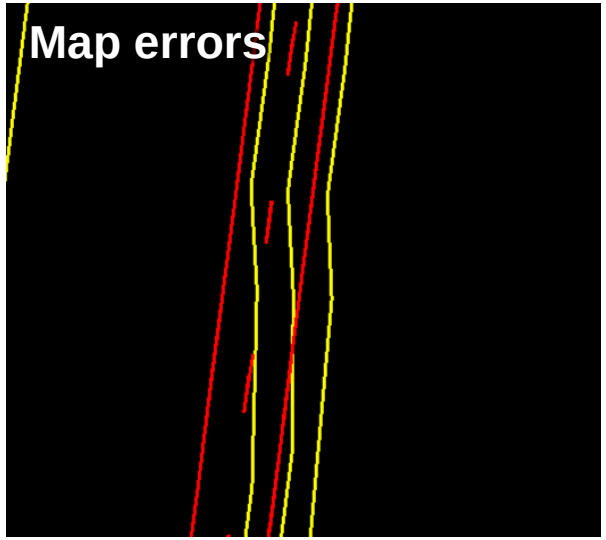
Challenges of Level 4/5

Many of these challenges occur when **HD map** is *inconsistent* with **live perception!**





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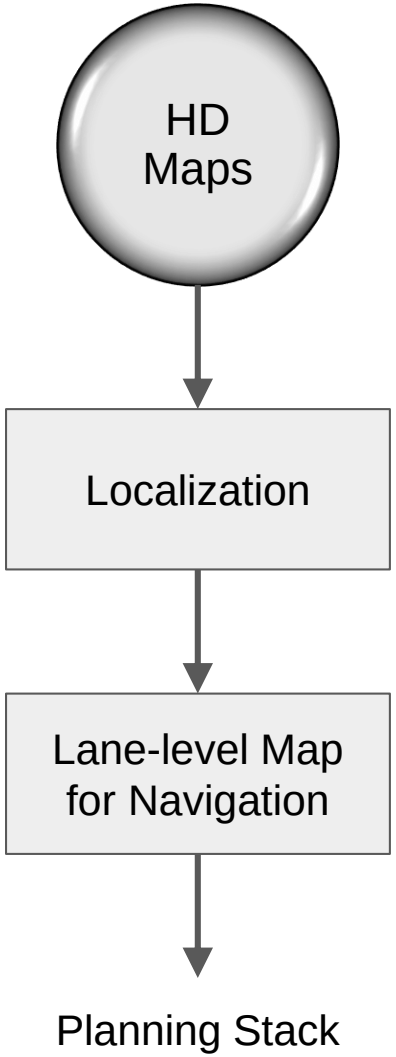
TRI HD Maps Mindset



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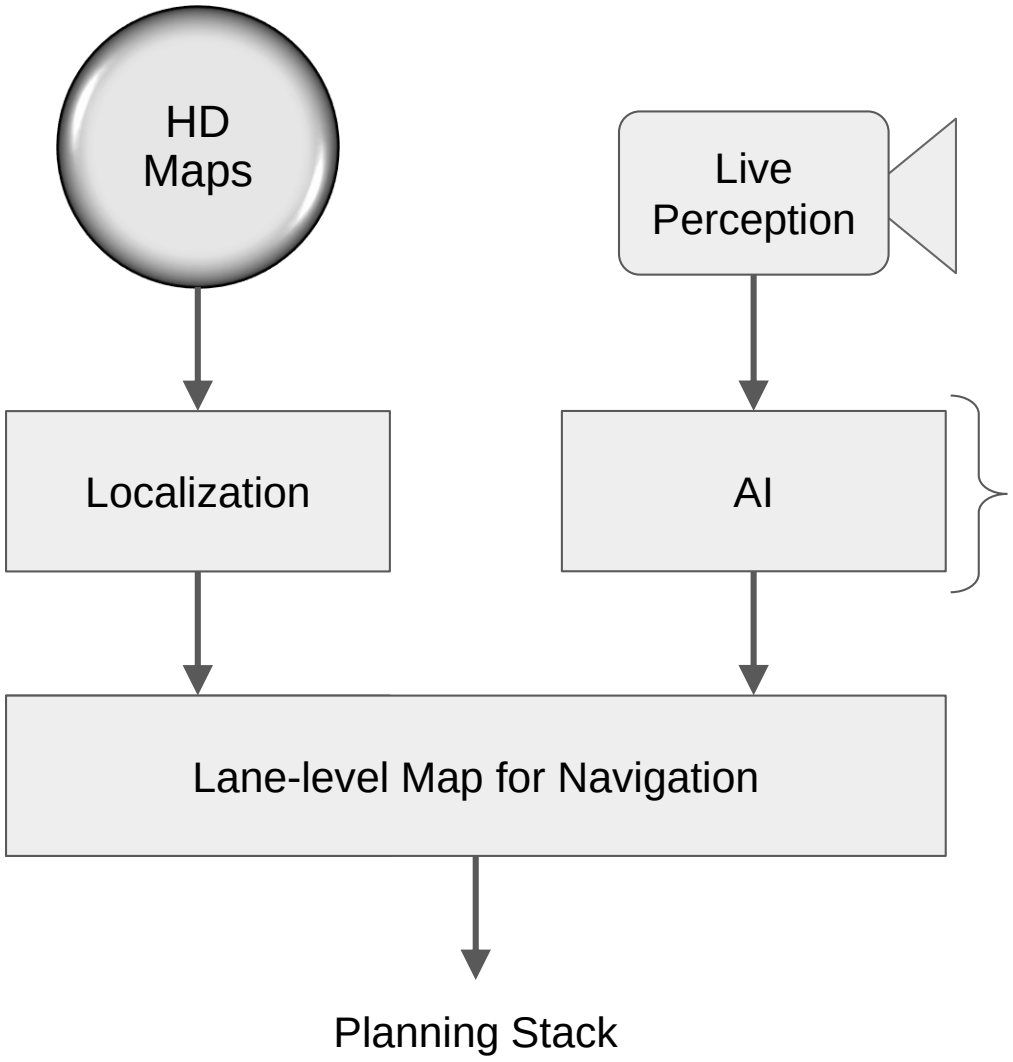
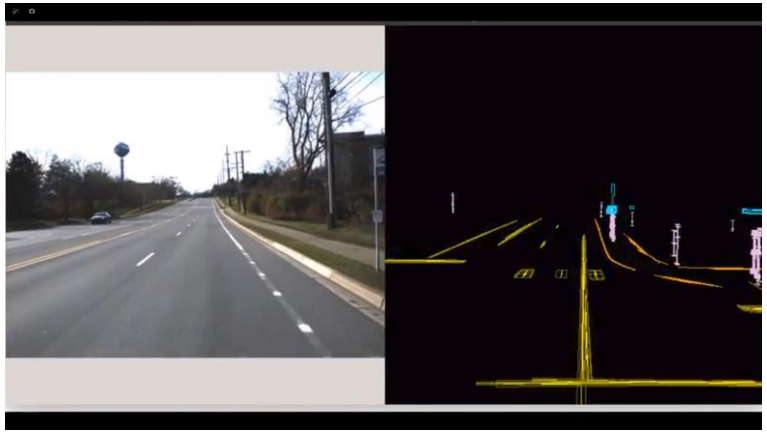


TRI Semantic Segmentation

TRI Feature Extraction



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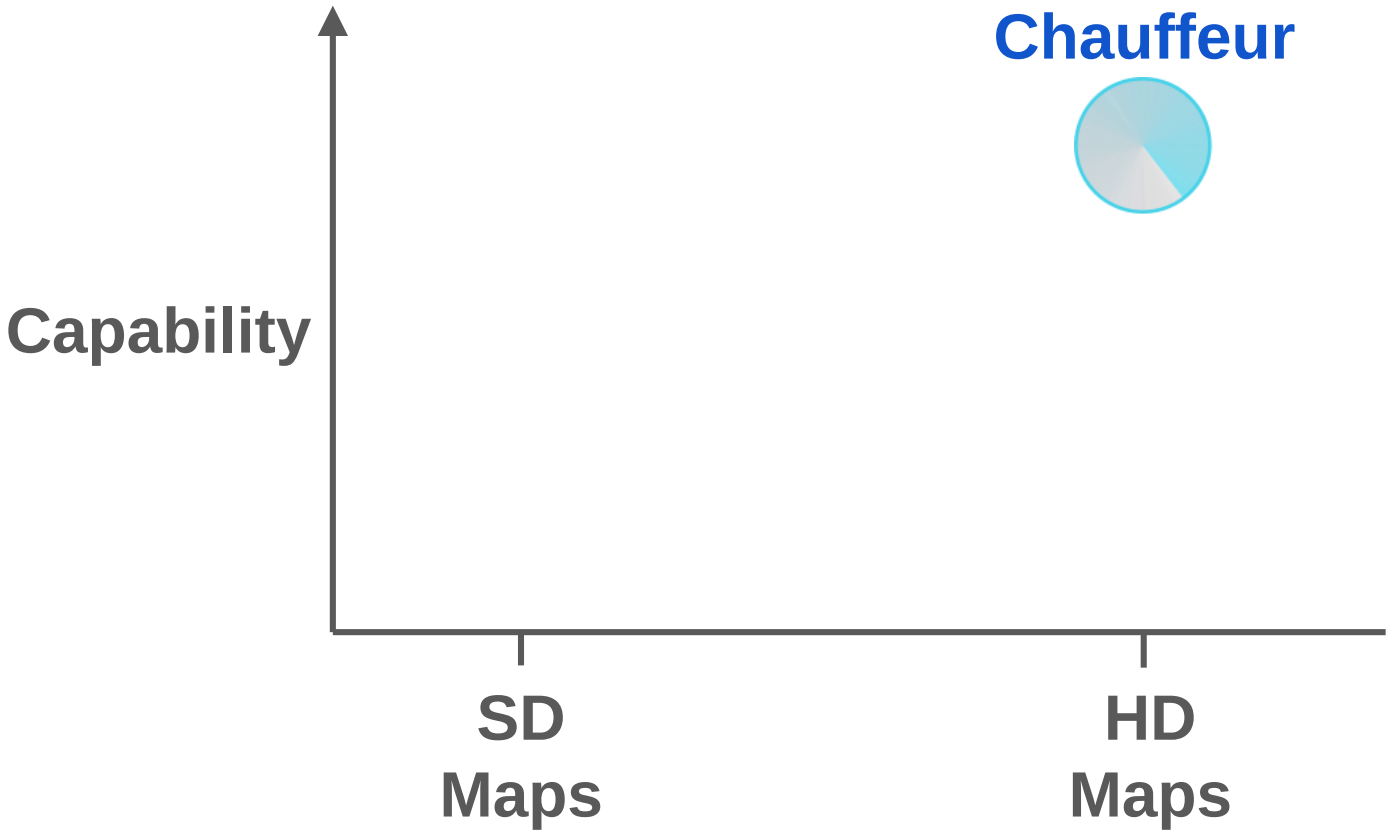
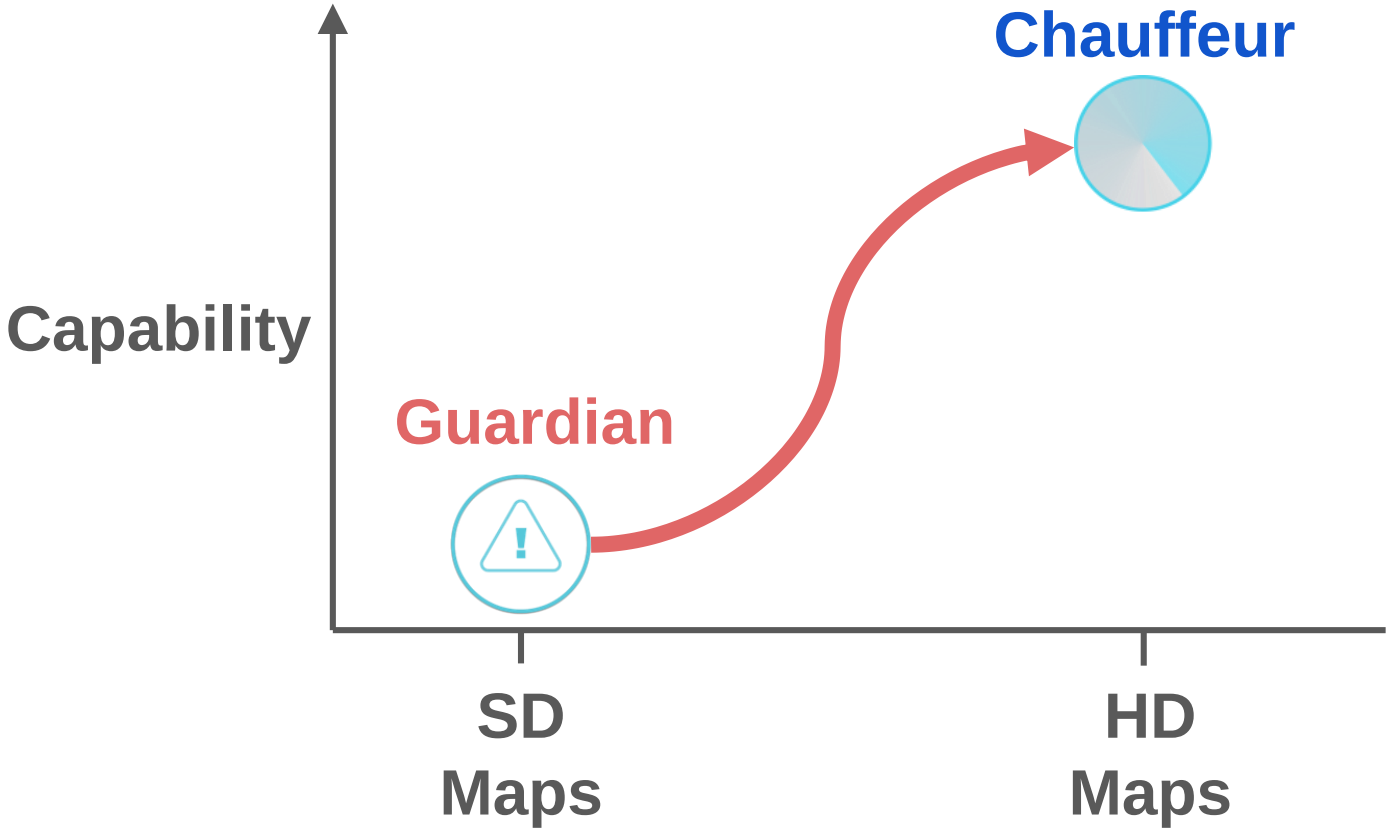
TRI Map Mindset → Guardian Connection

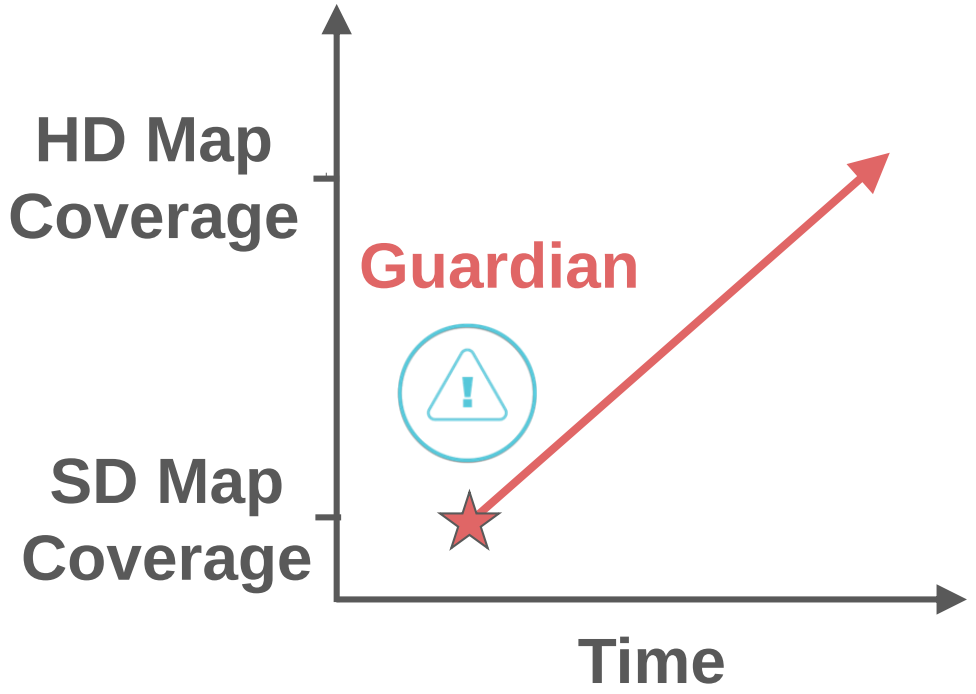


TRI Map Mindset → Guardian Connection

1) Some functionality everywhere, spectrum of map inputs



2) Learn map over time



TRI’s Automated Vehicle Testing Platform

Platform 3.0

- One of the most perceptive test cars on the road
  - 200m range
  - 360-degree coverage
- New integrated design that’s sleek and elegant
- Weatherproof rooftop panel seamlessly conceals equipment

Closing Perspective

- AI is the “brain” of the automated vehicle system
- Role of the map
- Challenge for Level 4/5 automation: inconsistency between map and live perception
- Possible solution: fuse AI with perception and maps
- Unique approach enables TRI’s exploration of Guardian mode

Thank You