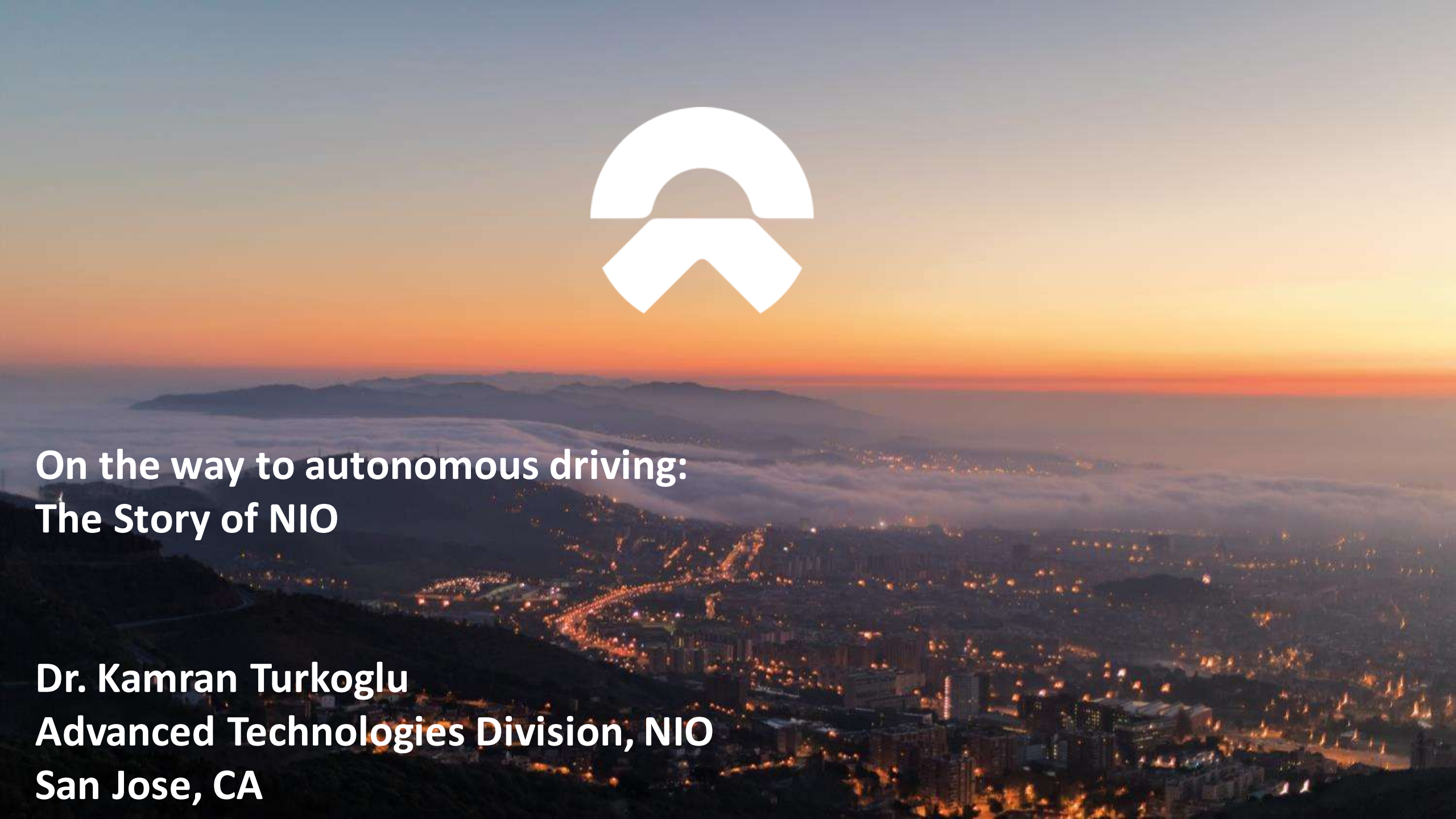


On the way to autonomous driving:
The Story of NIO

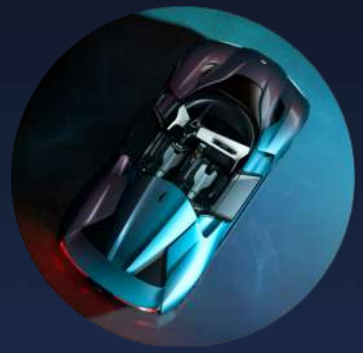
Dr. Kamran Turkoglu
Advanced Technologies Division, NIO
San Jose, CA

NIO is more than a car company

Conceived and planned since 2012 and formally founded on November 28, 2014. NIO is a global company that designs, develops, and produces smart, high-performance, premium electric vehicles. Our aspiration is to shape a better life for our users through thoughtful design, amazing services, and cutting-edge technology.

NIO's Products

FE Racing Car



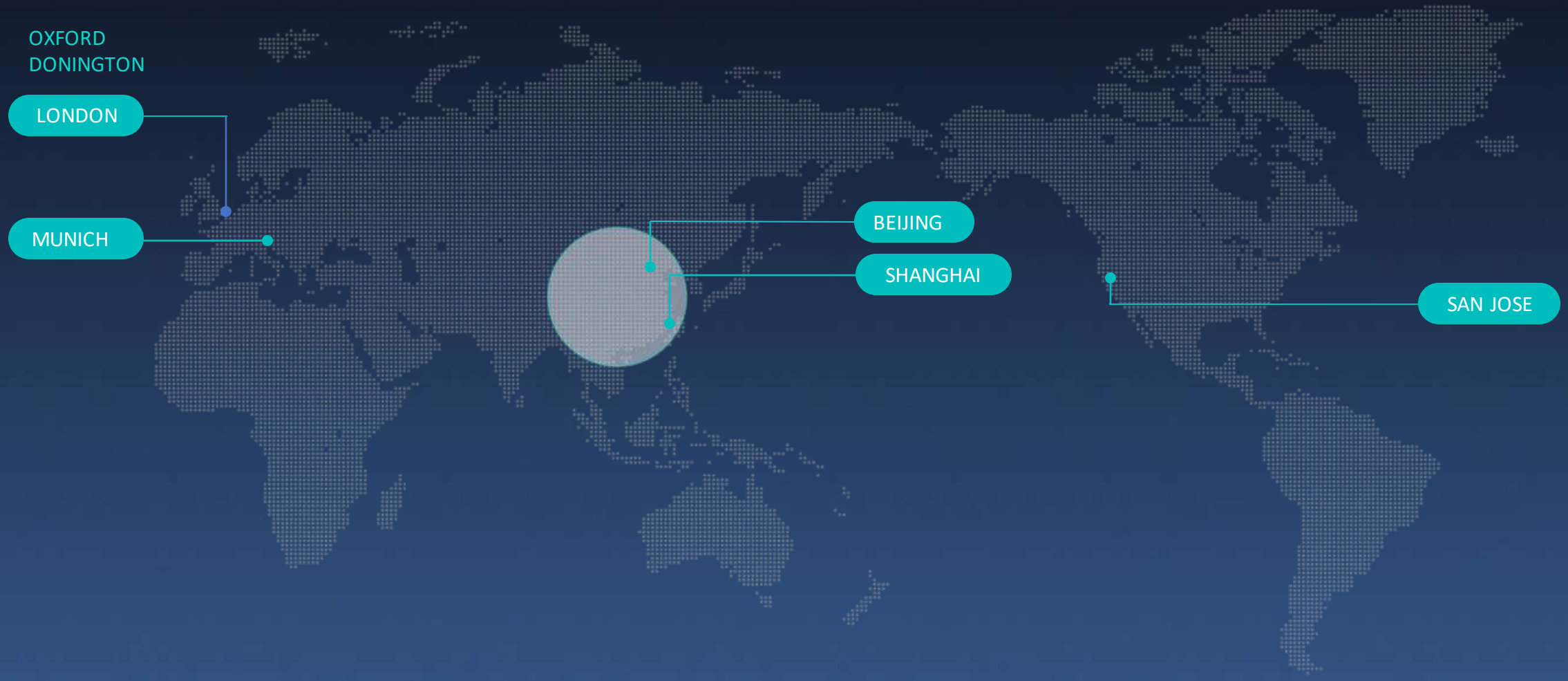
EP9

EVE

ES8

ES6

NIO has over 9,500 employees and world-class research and development, design, and manufacturing centers in Shanghai, Beijing, San Jose, Munich, London and other locations.



NIO USA - San Jose - Advanced Technologies Group:

HW/FW

SW & Algorithms

Perception

Systems Integration/Validation

350+ people

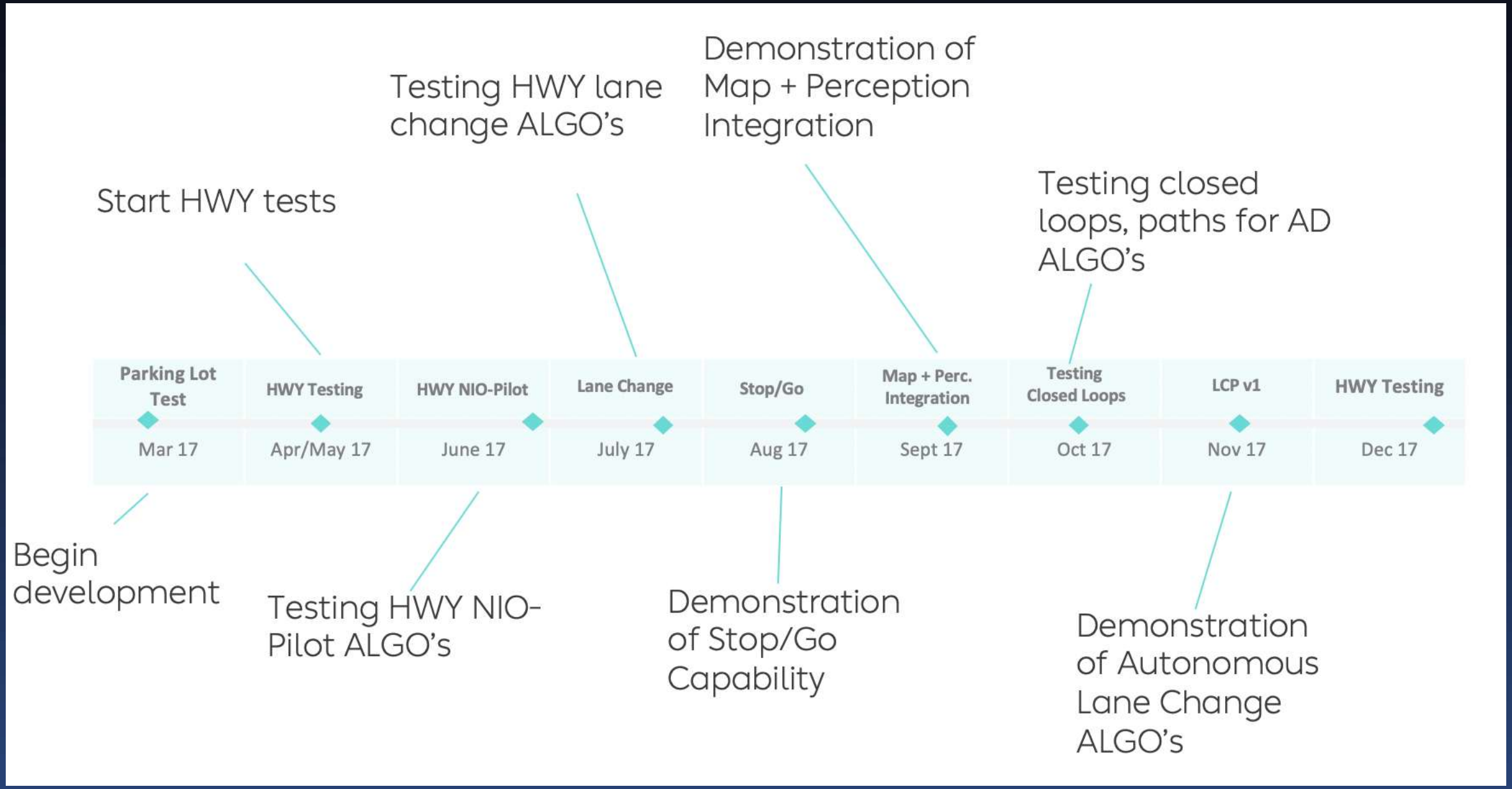
EP9 – Autonomous Lap Project 09/16 – 02/17

One of the Fastest Electric Cars in the World

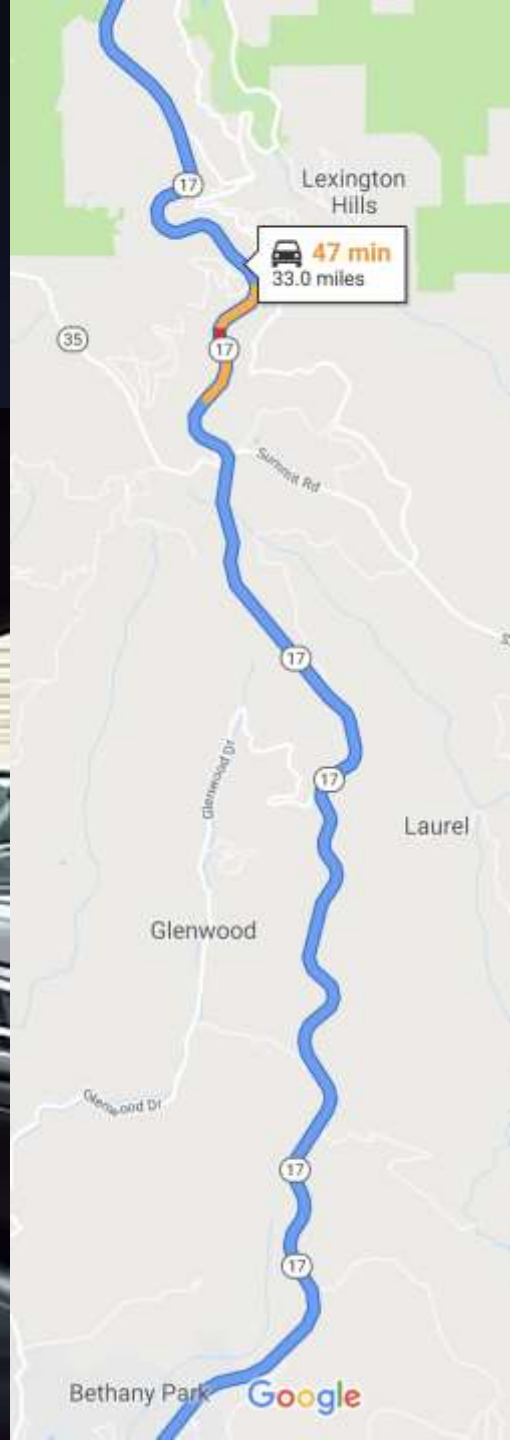
From Track to Road

TURN 19
OUT

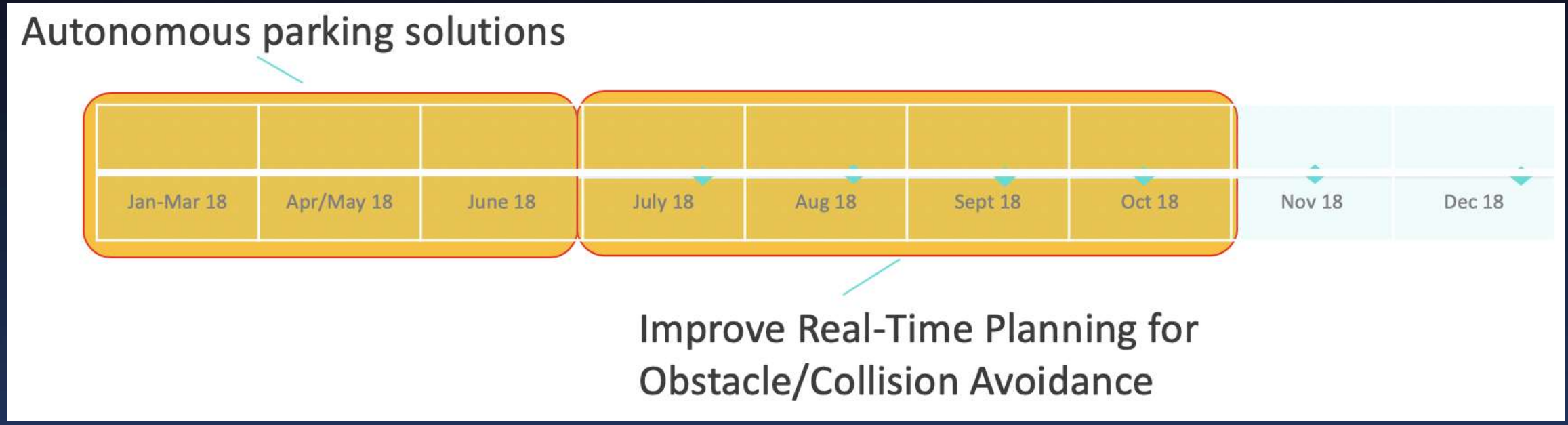
Autonomous Driving Platform: Timeline



Autonomous Driving Platform: **Timeline @ 10/2017**



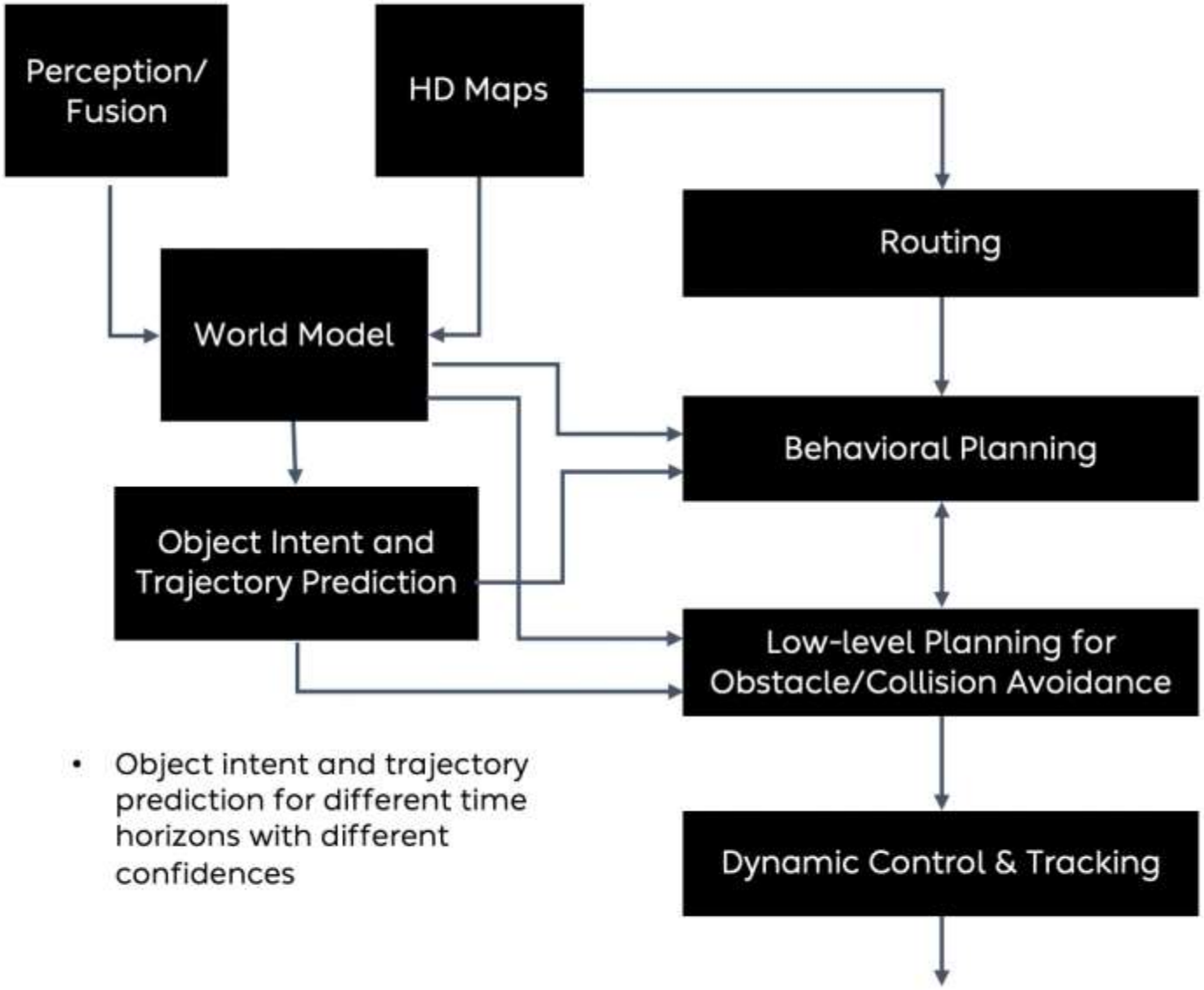
Autonomous Driving Platform: Timeline



Autonomous Driving Platform: L4

- **GOAL:**
  - **Fully redundant L4 Solution**
    - **(SW & HW)**
  - **Based on our EV platform**
    - **Release first HWY-L4**
      - **Extend to Urban setting**

ALGORITHMS



- Object intent and trajectory prediction for different time horizons with different confidences

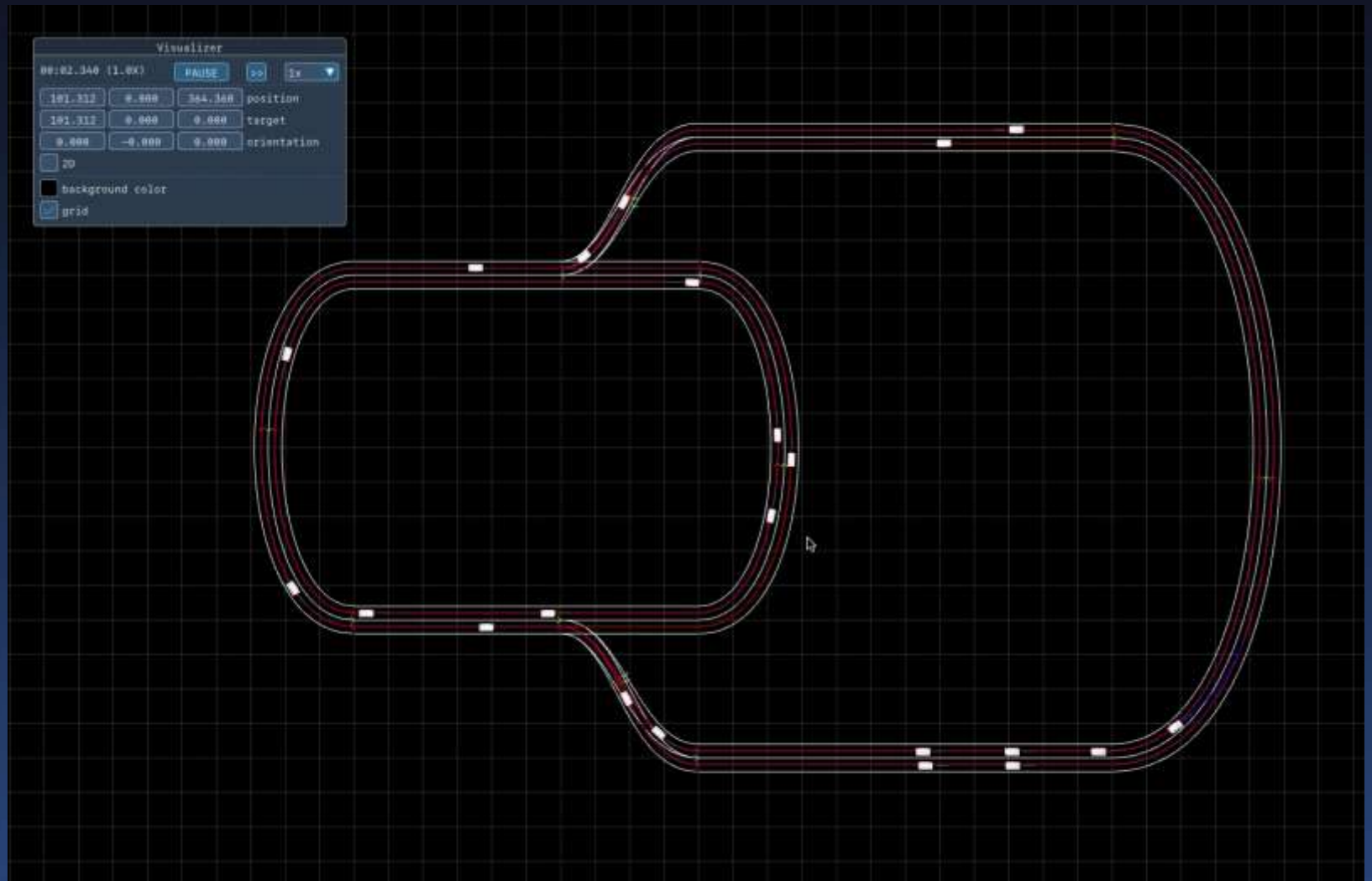
Horizon	Operating Frequency
Routing to final destination	1Hz
6-10 seconds	1-5 Hz
1-3 seconds	20-40Hz
	100Hz

Algorithm Selection and Evaluation

- Linear Systems theory
- Nonlinear Systems theory
- Stochastic Systems theory
- Markov processes
- Statistics based learning strategies

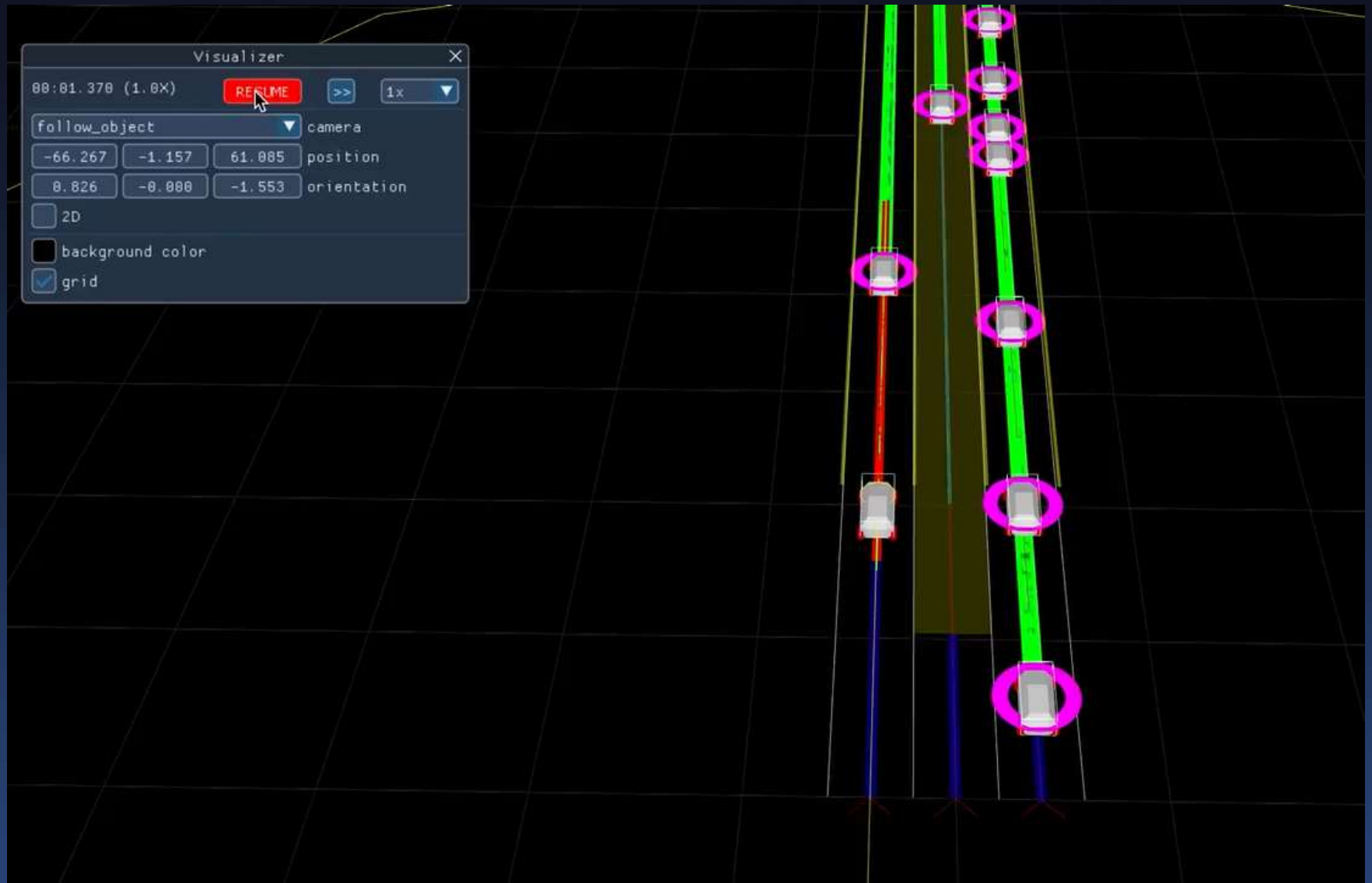
Testing, Validation and Simulations

- **Simulation environment: SIL & MIL**



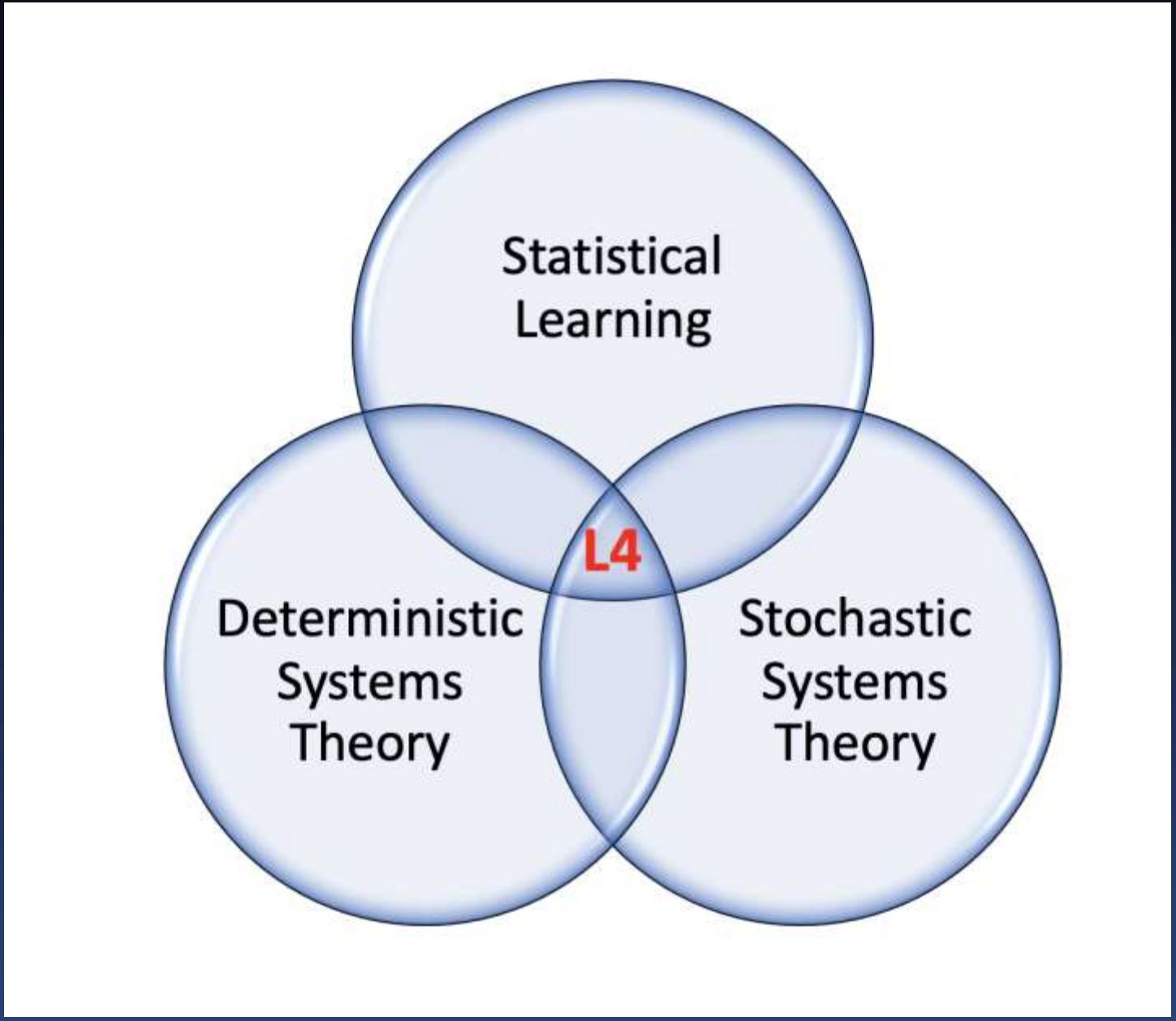
Testing, Validation and Simulations

- **Simulation environment: SIL & MIL**



L4 Autonomous Driving in HWY Environment

Problem domain and Solution



ALGORITHMIC CHALLENGES

- Achieving robustness guarantees
  - Handling qualities for all operation domain ad conditions

- Achieving safety/collision guarantees
  - 97.8% → is it enough?
  - 98.9%. → guarantee safety?

ALGORITHMIC CHALLENGES

- Testing and validation
  - `simulation-driven-miles`
  - `real-world-miles
    - How much is enough??

    - 5million miles?!
    - 10 million miles?!
    - 15million miles?!

ALGORITHMIC CHALLENGES

- Testing and validation
  - Different conditions
    - Mumbai vs. London vs. Melbourne
      - How do you guarantee same level of safety with different level of driving cultures?

Blue Sky Coming

Thank you