



# Highly Automated Driving (HAD) for Consumer Vehicles

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# A Tale of Two Markets for HAD Products: Geofenced Vehicles and Consumer Vehicles

- There are two distinct market segments for HAD products
  - ▶ **Geofenced vehicles** – Vehicles that travel in limited areas
    - Robotaxis, delivery vehicles, shuttles, etc.
  - ▶ **Consumer Vehicles** – Vehicles, owned by consumers and businesses, that travel anywhere, anytime
    - Passenger vehicles for work and personal use
- The different operational design domains (ODDs) for geofenced vehicles and consumer vehicles lead to substantial differences in HAD products



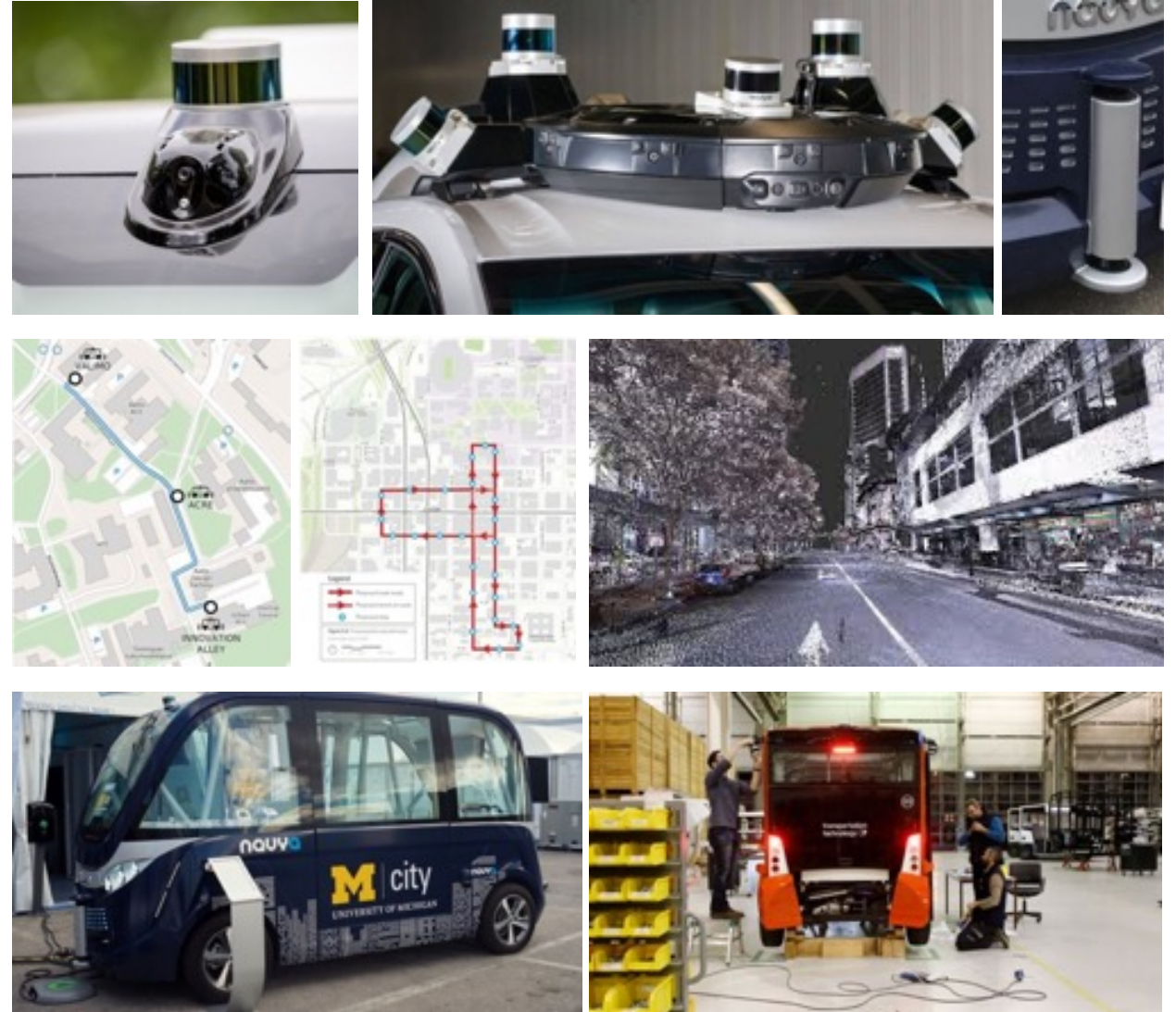
A Geofenced  
Vehicle –  
Autonomous  
Shuttle



A Consumer  
Vehicle –  
Cadillac CT6 with  
Super Cruise

# Geofenced Vehicles: Capabilities for Relatively Controlled ODDs

- Typically use more expensive image processing equipment and data storage than can be installed in consumer vehicles
- Only operate in a limited, predefined area
- Routinely return to central facilities



# Consumer Vehicles: Different Requirements for a Wide Range of ODDs

- Severe cost pressure
  - ▶ Production costs for sensors, processors, memory, and data
  - ▶ Ongoing costs including for data communications
    - Will need direct V2V communications for interaction with surrounding vehicles
- Wide range of operating environments
  - ▶ Potentially anywhere in the world
  - ▶ Almost all road types and weather conditions
- Non-specialist users
  - ▶ Users whose level of expertise varies widely
  - ▶ No control over repairs or updates



# Evolution of Permitted ODDs for HAD Products in Consumer Vehicles

- Most vehicle manufacturers are taking a gradual approach to rolling out HAD products
  - ▶ Increasing ADAS and HAD products to increase capability and user familiarity
  - ▶ Expanding the ODDs under which HAD products can operate
- Most vehicle manufacturers will launch SAE Level 2+/3 HAD products for consumer vehicles on selected expressways
  - ▶ Controlled access
  - ▶ Limited number of road configurations
  - ▶ Restricted permitted vehicle classes
  - ▶ Reliable road data available
- As HAD product capabilities increase, more ODDs can be permitted

# What Are the Priorities for HAD Product Development?

- What are the priorities for HAD product development?
  - ▶ Safety
  - ▶ The environment
  - ▶ Serving people without vehicles
  - ▶ Convenience of well-off consumers
  - ▶ Developing strategic technology
  - ▶ Etc.
- What type of vehicle aligns best with each potential priority?
  - ▶ Geofenced vehicles – buses, shuttles, pods, delivery vehicles, etc.
  - ▶ Consumer vehicles
- What public policies align best with each potential priority?
  - ▶ Public infrastructure
  - ▶ Urban planning
  - ▶ Industrial policy
  - ▶ Safety
  - ▶ Education
  - ▶ Etc.

# How Do Consumer Vehicles with HAD Products Fit into the World of Humanly Driven Vehicles?

- HAD will coexist with human driving for decades in many places
  - How good does an HAD product have to be?
- What technology or road configurations will be required to enable automated driving to cooperate and coexist with human driving?
- What is the potential impact of HAD on other businesses?
  - Airlines
  - Logistics
- What will happen when there are no more human drivers to observe and learn from?
  - Changes in software development
  - Changes in road design