Clearing the Validation Hurdle for Connected and Autonomous Vehicles

41st Automotive-Petroleum Industry Forum

April 12th, 2022
SO HOW MANY MILES TO VALIDATE AN AV?

Waymo >20M total self-driving miles, 74,000 driverless miles (2019)

To prove AV’s are 20% better than human drivers using a fleet of 100 AV’s driving 25 mph:

- Avoiding Crashes – 28M miles (1.3 years)
- Avoiding Injuries –170M miles (7.6 years)
- Avoiding fatalities – 5B miles  (225 years)

A SOBERING TREND IN TRAFFIC DEATHS

According to NHSTA
1.1 deaths per 100M miles (2019)
1.37 deaths per 100M miles (2020)
↑7.2% despite driving ↓13.2%
↑ 12% first 9 months of 2021

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SOLVING THE LONG-TAIL PROBLEM IN AUTONOMOUS DRIVING

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1.37 deaths per 100M miles (2020)
↑7.2% despite driving ↓13.2%
↑ 12% first 9 months of 2021

2019 Roadway Fatalities Report Released | NHTSA
2020 Fatality Data Show Increased Traffic Fatalities During Pandemic | NHTSA
Traffic Fatalities Rise in First Nine Months of 2021 | NHTSA

Long Tail of Events

Probability

Normal events

Rare events

Events

Identifying and validating to edge cases is essential to widespread AV deployment
A smart mobility test center integrates the physical and the virtual.
SMART MOBILITY TEST CENTER

Testing & Validation of Advanced Mobility Technologies

Connected and Autonomous Vehicles
Advanced Driver Assistance Systems
Electrification (XFC, V2G, Cyber)
Ecosystem for Future Mobility
COMPREHENSIVE REAL-ROAD TEST ENVIRONMENT

1. Real road systems
2. ITS Network Infrastructure
3. Specialized Test Equipment
4. Virtual/Digital Tool Chain
NETWORK INFRASTRUCTURE

PRIVATE 4G LTE & 5G SUB-6 CELLULAR

OPTIMIZED CELL COVERAGE

FIBER OPTIC CABLE BACKBONE

DSRC (15 RSUS)
Upgrading to C-V2X

UP TO 100 GBPS DATA TRANSFER

CLOUD - DATA MANAGEMENT & ANALYTICS PLATFORM
TEST EQUIPMENT: ROBOTIC SOLUTIONS, WEATHER, TARGETS

- Rental equipment and support services available
- SR60 TORUS STEERING ROBOT
- CBAR600 – COMBINED BRAKE AND ACCELERATOR ROBOT
- GST – GUIDED SOFT TARGET
- RAIN AND GRIME TRAILER TRUCK
- PEDESTRIAN SOFT TARGETS

American Center for Mobility
CONNNECTED. AUTOMATED. VALIDATED.
Autonomous Cloud Introduction

- Managed Service supporting critical data, analytics and development capabilities
- Eliminates upfront, multi-million $ investment and frees talent to focus on mission-critical activities
- Client-specific MVP release is delivered in approx. 12 weeks.

Data & Analytics
- Data Management & Analytics Platform (DMAP) + Cloud Services

Mapping
- 3D Point Cloud Maps + Public Roads

Modeling & Simulation
- Cloud Based Simulation Tools + Edge Case Solutions

Augmented Reality
- Mixed Reality Simulation + Naturalistic Adversarial Driving Environment (NADE)
Crash: BV cut-in AV
Highway Merging
Values of SAFE-TEST:
1 ACM Mile = 5000+Road Miles
Cost 50 – 100x Less

1. Reduce development costs
2. Compress development cycle
CAV TESTING NEEDS
Replicating Real World Scenarios:
• Sensors & perception
• Connectivity
• Interoperability
• Vehicle Interactions:
  • Real-world roads
  • Other vehicles
  • Other types of road use

Bringing together roads, sensors, ITS, tool chain and AV specific testing strategies to accelerate validation
CLEARING THE AV VALIDATION HURDLE

More advanced validation tools and resources are required to help reduce the amount of public road testing to validate AV’s for deployments.

- Public road testing is necessary but insufficient
- Integrated approach simulation, track, road
- More advanced tools
  - Augment Reality, Scenario Generation
- Affordable cloud-based tools
  - Data Management & Analytics
  - Simulation & Compute
- Interoperability (still yet to come)
- Standards (Industry, Federal, State)
Perspectives on Market Commercialization
CURRENT INDUSTRY FOCUS ON AUTOMATION

- Level 2+ is not industry standard definition
- Implies Level 3 capabilities but with driver fully engaged

Heavy focused on deployment of level 2+, with some level 3 for consumer vehicles and level 4 for commercial fleets
CONNECTIVITY

Cooperative Driving Automation (CDA) required for full transportation safety, efficiency and mobility benefits

- V2X (DSCR) – phasing out
- C-V2X / 5G – phasing in
- Assumes FCC ruling stands

AV’s will be deployed in parallel with increasing levels of connectivity
CELLULAR VEHICLE TO EVERYTHING (C-V2X) (TWO COMPLEMENTARY MODES)

**Direct**
- V2V, V2I, and V2P operating in ITS bands (e.g., ITS 5.9 GHz) independent of cellular network

**Network**
- V2N operates in traditional mobile broadband licensed spectrum

**Short range** (<1 kilometer), location, speed ...
- Implemented over “PC5 interface”

**Long range** (>1 kilometers), e.g. accident ahead
- Implemented over “Uu interface”

5GAA The C-V2X Proposition:

Mobile Network Operators (MNOs) have proposed that V2N can be fast and lower cost for early deployment.
STATUS OF 5G

- Still early stages of roll out
- Not all 5G is the same
  - Low, Mid, mm-wave
  - Coverage vs. Bandwidth
- Mid-Band is said to be sweet spot
- Advances mm-wave Antenna Systems
- Demonstration of V2N use cases
- Limited commercial private network deployment for transportation
CONNECTED AND AUTOMATED VEHICLES CORRIDOR

- MDOT working with Cavnue
- 40-mile CAV corridor between Ann Arbor and Detroit
- Managed lane for CAVs with connectivity to infrastructure
- Infrastructure financing model
- “Automated Vehicle Roadway” Proposed MI legislation SB 706
Is C-V2X / 5G sufficient for CDA? Can you get there with a mixed fleet?
COMMERCIALIZATION PERSPECTIVES

• **Technology** - Not the limiting the factor. Building blocks are available.
• **Design** - Many possible vehicle-infrastructure configurations. Which meet use case requirements?
• **Validation** - Use cases and with proper edge cases is a long pole in the tent
• **Build, Operate, and Maintenance of Infrastructure**
  • Municipalities want to see more vehicles before they invest in infrastructure
  • OEMs reluctant to burden vehicles with chip sets until they see more infrastructure
• **Finance** - Who pays for the benefits (public service, fee for service) is key?
• **Regulatory** – Both safety an energy efficiency policy considerations
  • NHTSA (FMVSS), States for Licensing & Operation
  • New Fuel economy test cycles, EPA window stickers (mpg, EV range), and innovative policy design
• **Market Acceptance** – Will adoption be market-driven by consumers?
Ways for API to Engage
Going Beyond CAV Testing
GROWING A DIVERSE MOBILITY ECOSYSTEM

ACM’s targeted efforts and customer base extends across a variety of industries that comprise the mobility ecosystem.

ACM’s focus is broad towards future mobility
ACM AREAS OF FOCUS

TECHNOLOGY DEVELOPMENT
- R&D
  - Test & Validation
  - Service Partner
  - Infrastructure Partner

MARKETING
- B2B
  - Technology Demonstration
  - Product Showcase & Launch
  - Enhancement Sponsor

CONVENING
- Standardization
  - Committees & Taskforces
- Networking & Events
- Roundtables

EDUCATION & WORKFORCE
- Training & Professional Development
  - STEM, K-12, Higher Ed
  - Challenges & Competitions
  - Consumer Awareness

There are many ways to engage in ACM ecosystem