Creating more livable communities by assisting our clients to navigate, plan, program and build a sustainable future through innovative transportation solutions that redefine mobility.
Advanced Mobility Group

TECHNOLOGY FACILITATION

PROGRAM MANAGEMENT

MOBILITY OPTIONS

INNOVATIVE TRANSPORTATION SOLUTIONS

www.amobility.com
Portfolio of Projects

- **SHARED AUTONOMOUS VEHICLE PROGRAM**
- **GOMENTUM STATION PROGRAM**
- **MOBILITY ON DEMAND, SHARED MOBILITY + MICRO MOBILITY**
- **TRAFFIC ENGINEERING + DESIGN**
- **CONNECTED AUTONOMOUS VEHICLE SIGNAL LAB**
- **I-880 + SR-4 INTEGRATED CORRIDOR MOBILITY**
- **BICYCLE, PEDESTRIAN, COMPLETE STREETS DESIGN + SAFE ROUTES TO SCHOOLS**
- **TRANSPORTATION DEMAND MANAGEMENT**
- **EXPRESS LANES + CONGESTION PRICING**
<table>
<thead>
<tr>
<th>GoMentum Features</th>
<th>SEND URE</th>
<th>EXPANSIVE</th>
<th>CONVENIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECURE</strong></td>
<td>With guards stationed at all entrances, no unauthorized personnel are allowed</td>
<td>With 2,100 acres available, multiple vehicles can be run without any interference</td>
<td>Just 50 miles from Silicon Valley, GoMentum enables agile work plans</td>
</tr>
<tr>
<td><strong>REALISTIC</strong></td>
<td>With features like tunnels, vehicles are subjected to real world obstacles &amp; scenarios</td>
<td></td>
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<tr>
<td><strong>VALIDATED</strong></td>
<td>Leading auto OEM and tech providers have tested at GoMentum since 2015</td>
<td></td>
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<tr>
<td><strong>FLEXIBLE</strong></td>
<td>GoMentum works with partners to determine what to build next to suit their needs</td>
<td></td>
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</tbody>
</table>
Contra Costa Transportation Authority (CCTA) and AAA awarded a $7.5 million grant from the U. S. Department of Transportation (USDOT) to support a four-year Automated Driving System (ADS) pilot program for three “real-world” demonstration projects.

- Rossmoor First Mile/Last Mile Shared Autonomous Vehicles, Walnut Creek, Calif.
- County Hospital, Accessible Transportation, Martinez, Calif.
- Personal Mobility on I-680 Corridor, Contra Costa County, Calif.
V2X Lab

AAA Northern California, Nevada & Utah
Why AAA?

AAA, a not-for-profit organization:

- Involved in original road signage
- Established emergency roadside assistance
- Tested and published guides on EVs and ADAS systems
- Child car seat legislation
SECURE · 2,100 ACRES · 20+ MILES · LOCATION
V2X Lab

• State-of-the-art lab to test V2I and V2V technologies to enhance safety and reduce congestion

• Equipped with advanced traffic signal controllers, video detection, DSRC/C-V2X/5G communication etc.

• Open to OEMs, Transit Agencies, Cities & Counties, DOTs, Universities, Vendors
Connected Autonomous Vehicle (CAV):
Navigates intersection based on traffic data feeds from RSU and OBU
Communication: 5.9 GHz / 5G

DSRC/C-V2X OBUs:
Receives traffic data from and sends car data to RSU
Communication: 5.9 GHz / 5G

DSRC/C-V2X RSUs:
Provides traffic data to and receives vehicle data from OBU
Communication: 5.9 GHz / 5G

Roadside Information Hub:
Collects traffic data and uploads to cloud; Provides edge data processing capabilities
Communication: DSRC, C-V2X, 5G, Fiber
Genesis of V2X Lab

- SAV testing experience in multiple cities (Las Vegas, San Ramon)
- Need temporary signal controller installation in parking lots in each city
- Expensive, time consuming, unnecessary
Potential Benefits

- **Cities and OEMs** do not have to build their own lab for this testing
- **Equipment evaluation** from multiple vendors before deployment
- **Feature and interoperability testing** before deployment
- **Demonstration to key stakeholders** (Council members, Maintenance crews, etc.) for buy-in
Current List of Vendors

Controllers

DSRC/C-V2X

Controllers
## V2X Applications

### V2I Safety
- Red Light Violation Warning
- Curve Speed Warning
- Stop Sign Gap Assist
- Spot Weather Impact Warning
- Reduced Speed/Work Zone Warning
- Pedestrian in Signalized Crosswalk Warning (Transit)

### V2V Safety
- Emergency Electronic Brake Lights (EEBL)
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Do Not Pass Warning (DNPW)
- Vehicle Turning Right in Front of Bus Warning (Transit)

### Agency Data
- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- Vehicle Classification-based Traffic Studies
- CV-enabled Turning Movement & Intersection Analysis
- CV-enabled Origin-Destination Studies
- Work Zone Traveler Information

### Environment
- Eco-Approach and Departure at Signalized Intersections
- Eco-Traffic Signal Timing
- Eco-Traffic Signal Priority
- Connected Eco-Driving
- Wireless Inductive/Resonance Charging
- Eco-Lanes Management
- Eco-Speed Harmonization
- Eco-Cooperative Adaptive Cruise Control
- Eco-Traveler Information
- Eco-Ramp Metering
- Low Emissions Zone Management
- AFV Charging / Fueling Information
- Eco-Smart Parking
- Dynamic Eco-Routing (light vehicle, transit, freight)
- Eco-ICM Decision Support System

### Mobility
- Advanced Traveler Information System
- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (transit, freight)
- Mobile Accessible Pedestrian Signal System (PED-SIG)
- Emergency Vehicle Preemption (PREEMPT)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)
- Incident Scene Pre-Arrival Staging
- Guidance for Emergency Responders (RESP-STG)
- Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
- Emergency Communications and Evacuation (EVAC)
- Connection Protection (T-CONNECT)
- Dynamic Transit Operations (T-DISP)
- Dynamic Ridesharing (D-RIDE)
- Freight-Specific Dynamic Travel Planning and Performance
- Drayage Optimization

### Road Weather
- Motorist Advisories and Warnings (MAW)
- Enhanced MDSS
- Vehicle Data Translator (VDT)
- Weather Response Traffic Information (WxTINFO)

### Smart Roadside
- Wireless Inspection
- Smart Truck Parking

*Source: US DOT*
Conditional Priority for Buses
Priority for Emergency Vehicles
Why Should We Care?

37,000+ Deaths / year

40+ Hours / yr spent in traffic

80% Crashes can be addressed by V2X

Source: US DOT
Offerings

• Training/tutorial
  - 1 day training: V2X basics, ITS overview
  - 2 day training: Setup of V2I environment
  - 3 day training: Interoperability testing

• Access to the site
  - 1/2 day access
  - 1 day access
  - 5 day access
Contact Info

Kris Harikrishnan
kris.harikrishnan@norcal.aaa.com
V2X: Vehicle to Everything

- Direct
- 100s meters
- Low latency
- Ad hoc
- 360° or narrow beam
- Mbps to Gbps
- Free spectrum

Source: Toyota
V2X Technology Benefits

**Increase safety**
ability to detect invisible obstacles to line-of-sight only vehicle sensors

**Reduce citizen complaints**
improve efficiency on the road and reduce congestion

**Enhance community well-being**
ability to allow priority passage of public transit buses and emergency vehicles
## DSRC vs C-V2X

### DSRC:
- Point-to-point
- Since 2004
- Sizeable deployments
- Uses 5.9GHz spectrum
- Toyota, Europe

### Cellular V2X (C-V2X):
- Point-to-point
- Since 2016
- Deployments in 2022
- Uses 5.9GHz spectrum
- Ford, China

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### Next Generation V2X (NGV)

TS 10 NEMA Standards
DSRC Road Side Units (RSU) in the US

26 States covering 79% of US population

Total Deployed & Planned = 5,315 so far

Source: Toyota
“V” Model of Development

Agile Approach
Pilots + Early Proof of Concepts

Testing Facility
CAV V2I Signal Lab

- Trailer with Signals (4-way)
- Power Generator (120VAC)
- ATC Cabinet
- ATC Controller
- 4G Interface
- CV Interface
- Road Side Unit (RSU)
CAV V2I/V2V OBUs

- On-Board Unit (OBU)
- Antenna(s)
- Power Adapters
- On-board WiFi/Access Point
- Tablet (Monitoring & Testing)
- Vendor(s) Android-based test apps
- Laptops (Monitoring & Configuration)
The image contains a table with columns for Prioritator Status, State, Arrival Time, Remaining Max Time, and Remaining Min Time. The table entries show that all prioritators are currently inactive.

The table also includes a second section labeled Priority Request Server Request Status. This section contains columns for Request ID, Vehicle ID, Vehicle Class Type, Service Strategy Number, Time of Service Desired, Time of Estimated Departure, Status in FRS, Time of Message, Time to Live, and Time of Service Destined in FRS.

The data entries include various values, such as Request ID 200, Vehicle ID 11204, Service Strategy Number 3, and Time of Service Desired 15.

An embedded YouTube video is also present, with the URL: https://www.youtube.com/watch?v=82AbX-rMP90&feature=youtu.be
Cooperative Intersection Collision Avoidance System (CICAS)

Applications:

- Red-light violation warning (RLVW)
- Curve speed warning (CSW)
- Signalized left turn assist (SLTA)
- Spot weather information warning—reduced speed (SWIW-RS)
- Vulnerable Road User Protection (Warning from Bikes and Peds)
Thank you