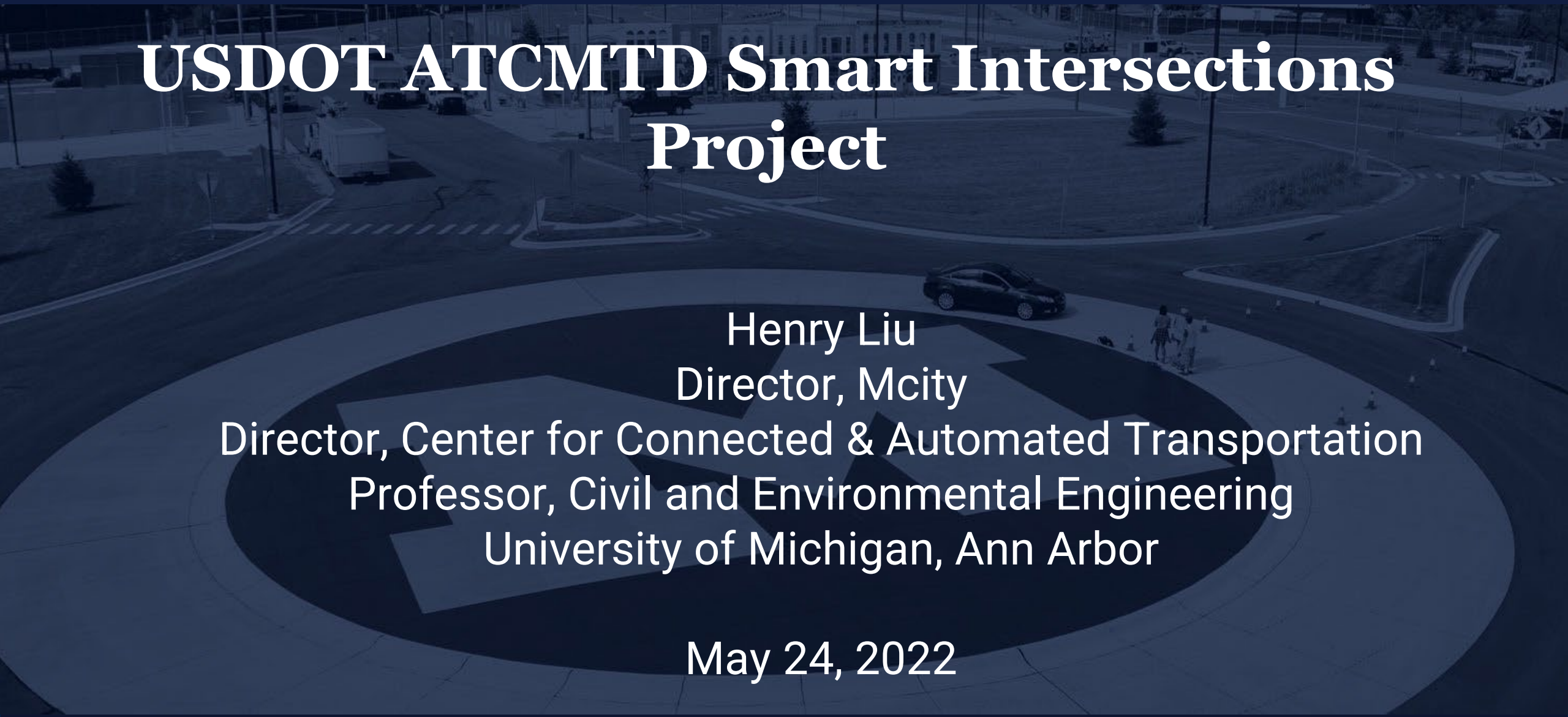


M | city
UNIVERSITY OF MICHIGAN

LEADING THE TRANSFORMATION
TO CONNECTED AND AUTOMATED VEHICLES

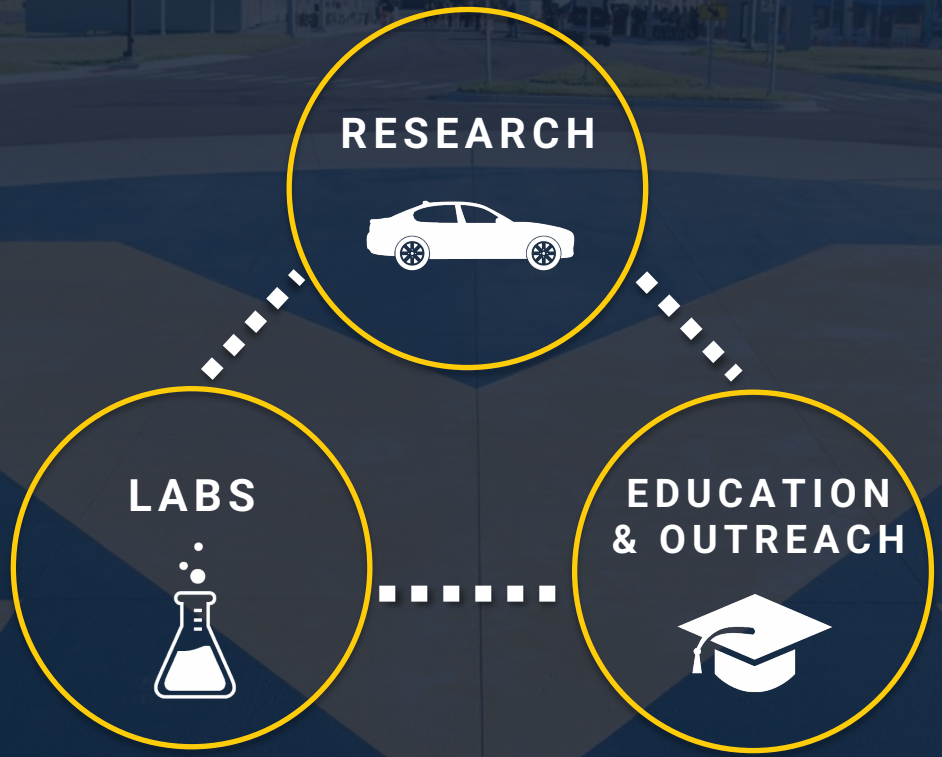
USDOT ATCMTD Smart Intersections Project

Henry Liu
Director, Mcity
Director, Center for Connected & Automated Transportation
Professor, Civil and Environmental Engineering
University of Michigan, Ann Arbor

May 24, 2022

Public-Private Partnership

- Pre-competitive research
- Pooled and tailored



- Mcity test track
- Mobility data center

- Voice of reason
- Talent development

CCAT: USDOT Region 5 UTC

- University of Michigan (Lead)
- Purdue University
- Univ. of Illinois, Urbana Champaign
- Central State University
- University of Akron
- Washtenaw Community College

CENTER FOR CONNECTED AND AUTOMATED TRANSPORTATION

ccat.umtri.umich.edu

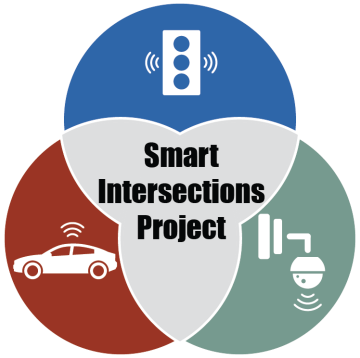
Mission: Significantly impact the evolution of the U.S. next-generation transportation systems with emerging technologies on safety, mobility, and sustainability.

Ann Arbor Connected Automated Vehicle Living Lab

SPMD Launched
August 21, 2012
$30M

Ann Arbor Connected Vehicle Test Environment (AACVTE), Completed March 31, 2019
$15.2M

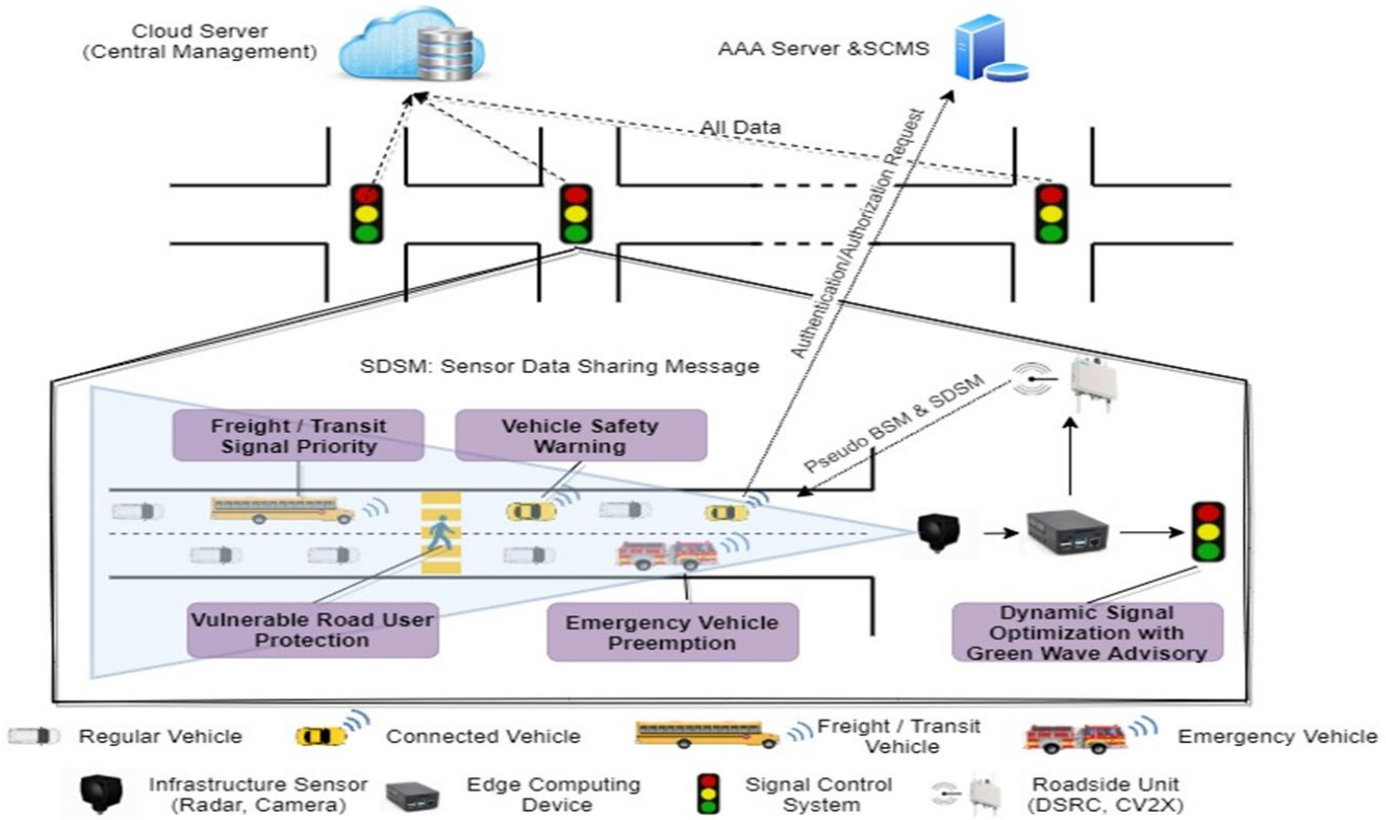
Ann Arbor Connected Environment, Operations and Maintenance
$4.4M
(2019-Present)



Smart Intersection Project
$19.9M
(2021-Present)

Smart Intersections Project

Develop an infrastructure-assisted cooperative driving automation ***testbed*** to accelerate CAV deployment



University of Michigan Transportation Research Institute (UMTRI)

PI: Dr. Henry Liu

Co-PI: Dr. James R. Sayer

PM: Debby Bezzina

Deputy PM: Mary Lynn Buonarosa

Collaborators

Ford

Qualcomm

TOYOTA

Sub-recipients

City of Ann Arbor Michigan

Continental

iteris

ECONOLITE

P3M

Purdue University

WSP

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Smart Intersections Project

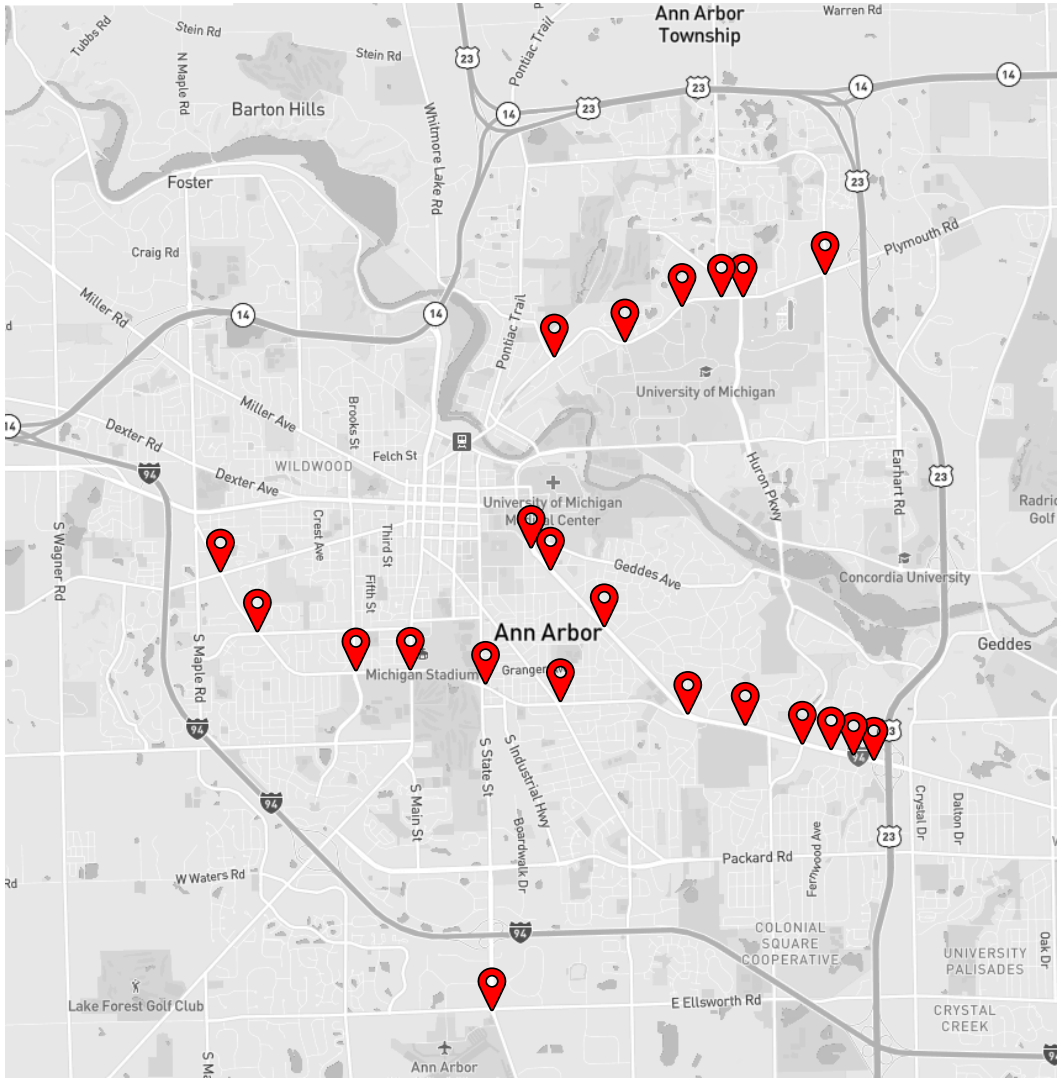
- Deploy a network of smart intersections in Ann Arbor, MI
  - Vehicles and infrastructure interact in a connected environment
- At each of the smart intersections:
  - Install roadside perception sensors
  - Generate and broadcast either proxy BSMs or sensor data sharing messages (SDSMs)
  - Test and validate the message information to establish trust with CAVs
  - Deploy edge-cloud infrastructure for other ITS applications (signal priority and greenwave speed advisory)

Smart Intersections Project Goals

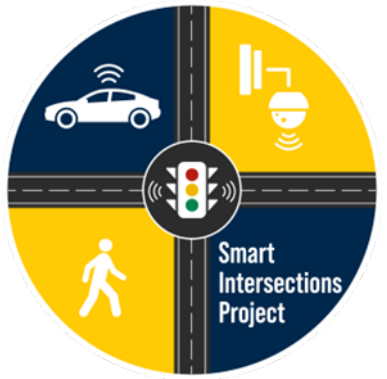
- Develop an infrastructure-assisted cooperative driving automation ***testbed*** to accelerate CAV deployment
  - Verifying the trustworthiness of infrastructure perception messages for CAVs
- Create utility for stakeholders by providing a roadmap for commercialization of CAVs
  - Ensuring wide scale benefits of CAV infrastructure without wide scale adoption
- Develop implementation guide – provide tools to build a self-sustainable CAV ecosystem
  - Generating revenue to facilitate investment needed to build CAV Infrastructure

Smart Intersection Deployment

- Support cooperative driving automation
  - First testbed in the US
- Support traffic management
  - Signal optimization
  - Green wave speed advisory
  - Improve environmental sustainability
- AWS-based mobility data center



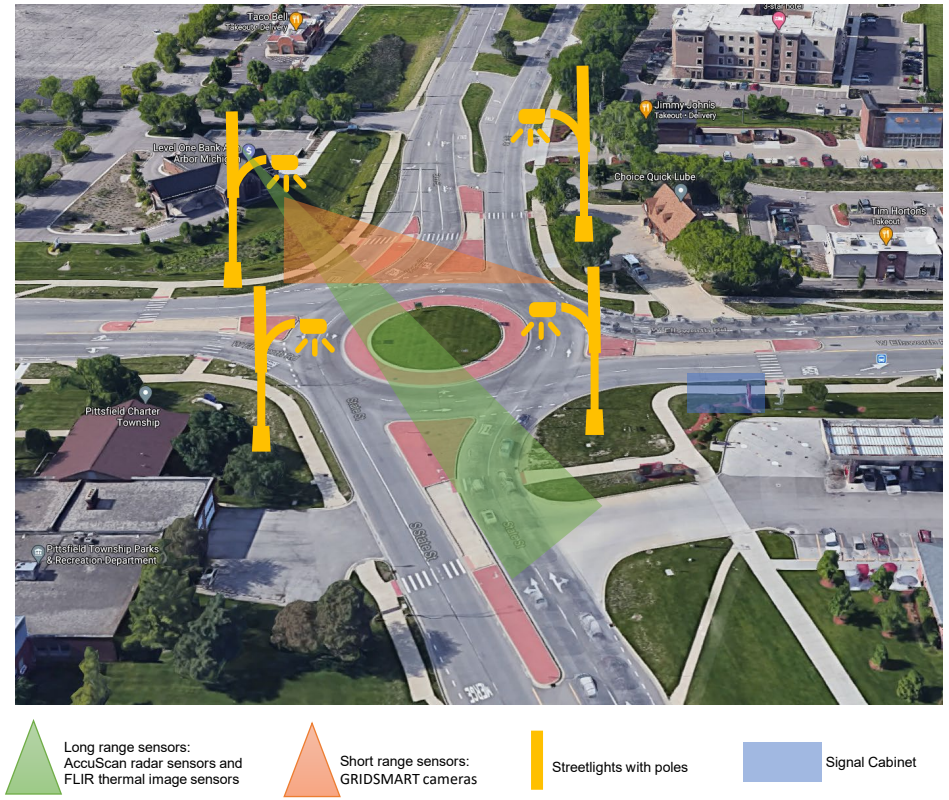
Benefits to the first responders

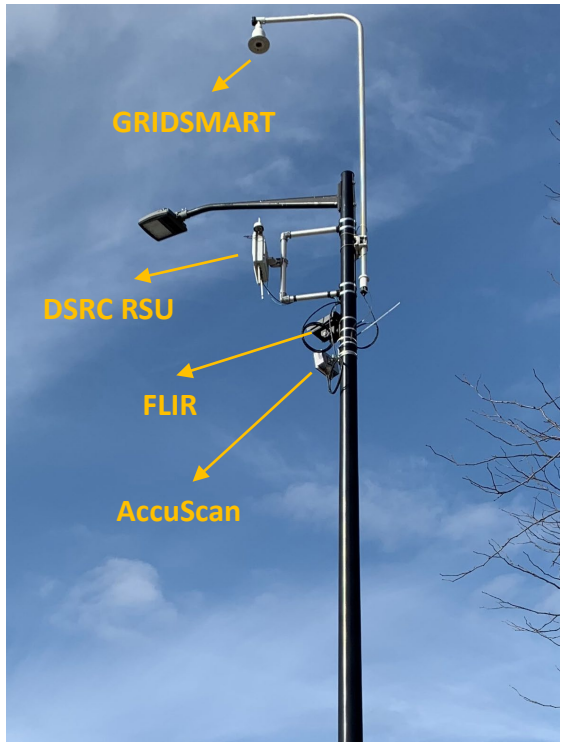


- Identify the crashes in real-time
  - You will be notified earlier
- Provide traffic signal priority or preemption
  - You can get to the crash site earlier

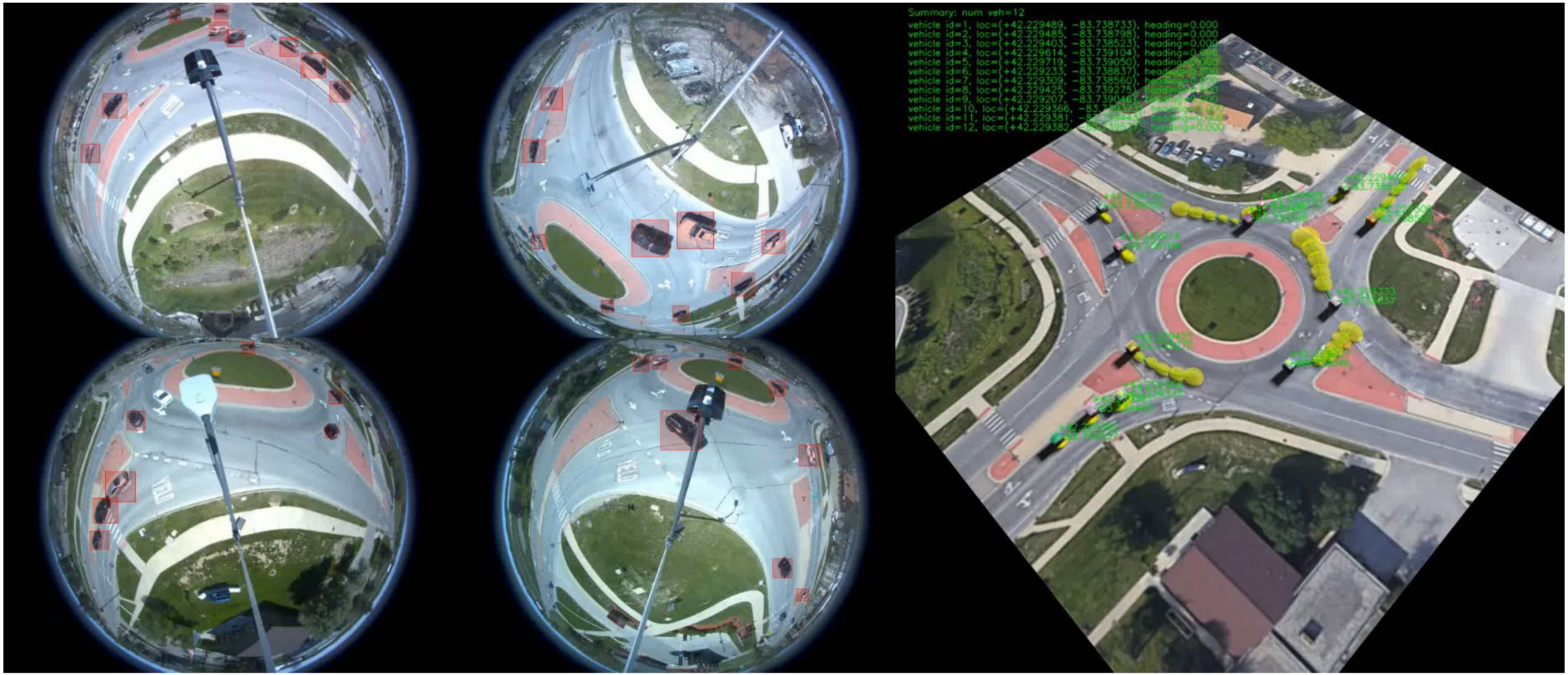
Instrumentation at State St./Ellsworth Rd Roundabout in Ann Arbor

- In 2020, State St./Ellsworth Rd roundabout had 69 crashes and 6 injuries and was ranked #14 for the most dangerous intersections in Michigan.





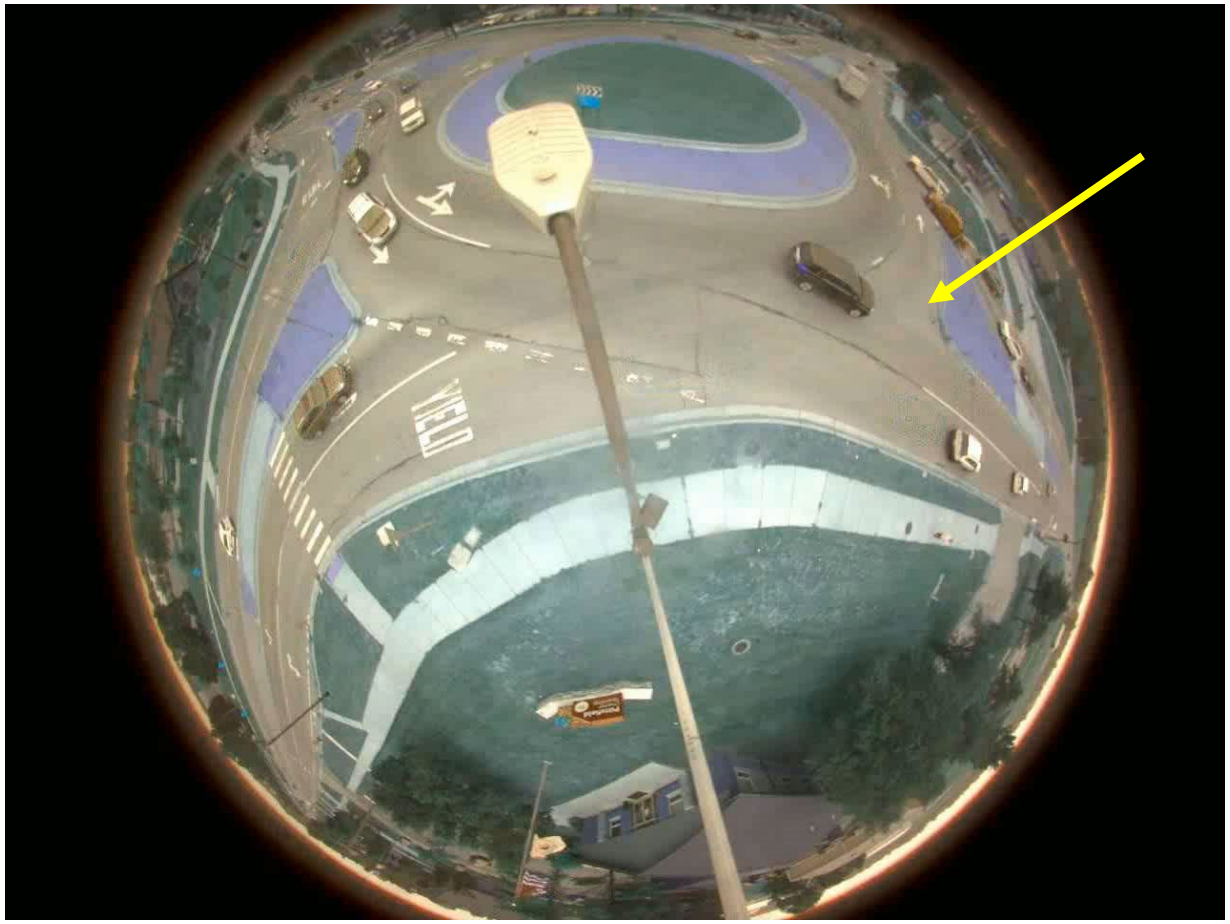
Object Detection, Fusion, Tracking, and Prediction



Zou, Z. et al., ICRA 2022

State St./Ellsworth Rd

Identified Crash/Near-Miss Events



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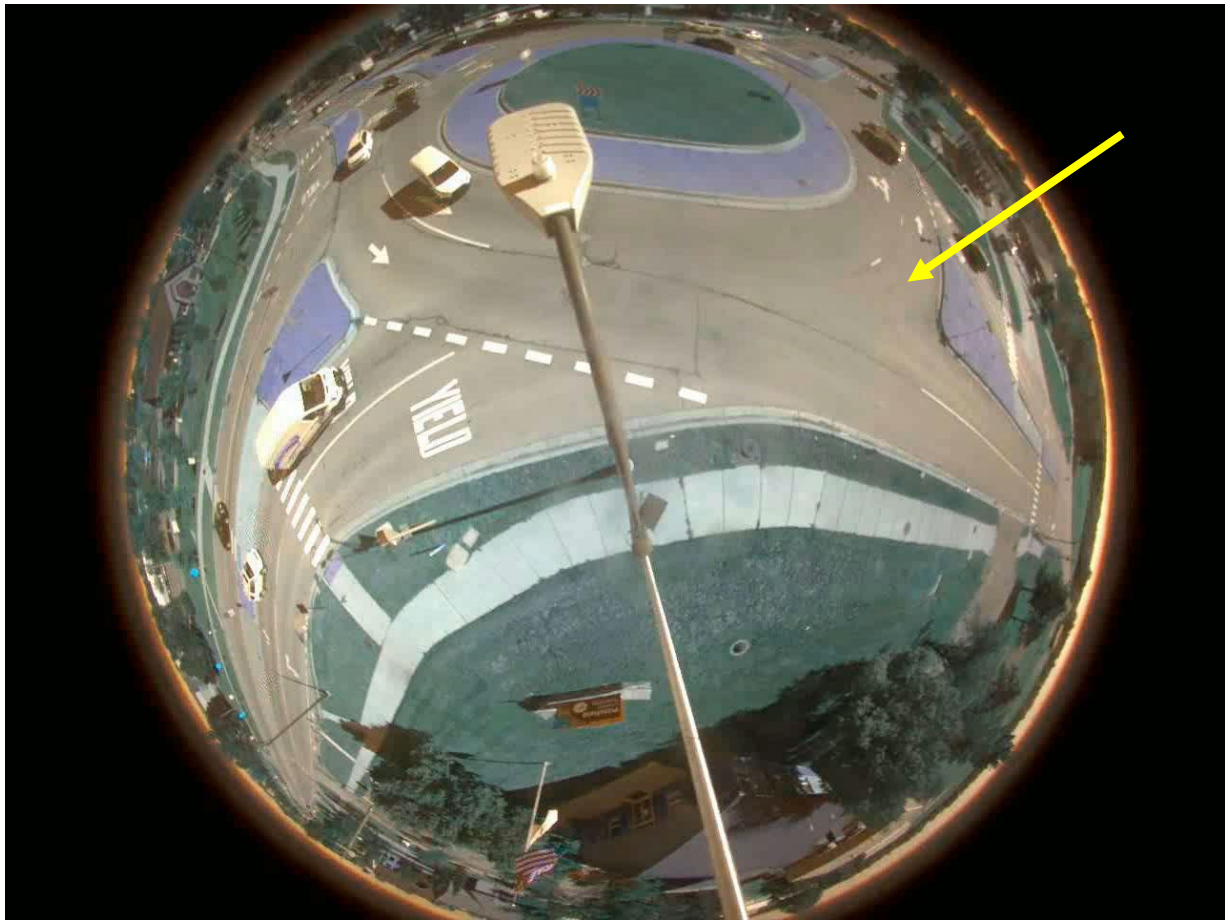

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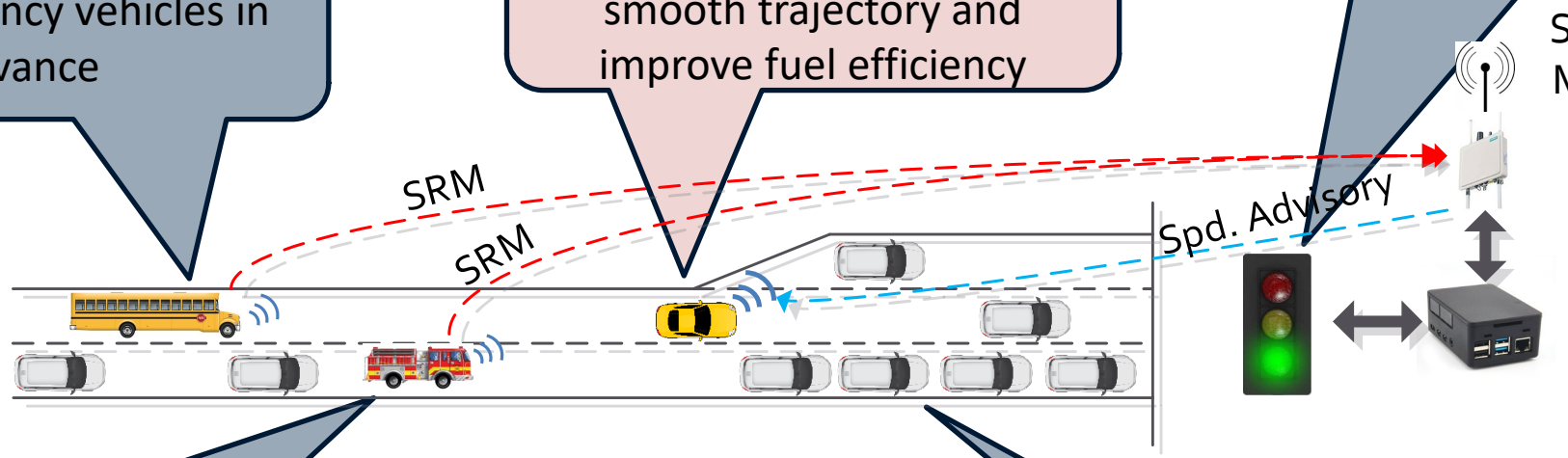
Signal Priority (Preemption) and Speed Advisory

SPaT: Signal Phasing and Timing
SRM: Signal Request Message

Detect approaching priority and emergency vehicles in advance

Provide speed guidance to connected vehicles to smooth trajectory and improve fuel efficiency

Extend green or truncate red for priority or emergency vehicles to pass the intersection with minimum delay



Send priority requests automatically when the siren is active

Clear downstream queuing vehicles that blocks the roadway to ensure safety

 Priority Vehicle

 Emergency Vehicle

 Connected Vehicle

 Regular Vehicles

 Edge Computing Device

 Roadside Unit

The Smart Intersections Project can help

Thank You!