

# Mcity Test Facility: An Outdoor Lab

The Mcity Test Facility sits on a 32-acre site on U-M's North Campus Research Complex, with more than 16 acres of roads and traffic infrastructure. The full-scale outdoor laboratory simulates the broad range of complexities vehicles encounter in urban and suburban environments.

- State-of-the-art instrumentation throughout the facility includes control network to collect data about traffic activity.
- Augmented reality testing technology allows physical test vehicles to interact with virtual connected vehicles in real time.
- Open-source API controls testing conditions throughout the facility.
- Infrastructure can be controlled with software.
- The facility uses vehicle-to-everything (V2X) communication and 5G connectivity.

Link to interactive map: [go.um.city/map](http://go.um.city/map)

Straight gravel roadway with a rural railroad crossing

Traffic circle, a smaller version of a roundabout that is common in Europe and some older cities in the U.S.

Construction and work zones with flagging, manhole, lane closure

Software-controlled traffic signals within intersections in different configurations, with mast arms, wood and metal poles, and pedestrian crossings

Pavilion with network access and safety equipment

Active railroad crossing with software-controlled gates and signals

Trunk line road, a rural roadway with a fully equipped railroad crossing, guard rail, and temporary and permanent pavement markings

Brick paver road simulated with stamped concrete

Underpass, simulated by a tunnel that blocks wireless and satellite signals from reaching vehicles

Roundabout, an increasingly common approach to intersection design intended to improve safety

ENTRANCE

Garage for test vehicle storage

Bike lanes, bike racks, and bicycles

Variety of pedestrian crossings



Open test area configurable for a wide range of scenarios, including parking lots and novel intersection geometries

4-way stop intersection, with straight as well as tight and sweepingly curved approaching roadways

Overhead highway signs

Tree canopy, a simulated tree cover that reproduces the attenuation of signals that pass through trees

Metal bridge deck, a bridge surface that poses special challenges for radar and image processing sensors

Electrical panel for events and vehicle charging

Building facades up to two stories high allow researchers to test the effects of various materials and geometries on sensor performance

Meandering gravel roadway

Sensors for data collection

Limited access freeway with access ramps, highway signage, guardrails, crash attenuators, and a concrete Jersey barrier

Ramp metering

Calibration mound to calibrate inertial measurement sensors on vehicles

Open test area

Robotic platforms include deer and pedestrian mount

Outdoor seating with table, chairs, and bike racks

Adjacent to Test Facility: Michigan Traffic Laboratory, the traffic control center for Mcity

## Hardware

1. Roadside Perception Sensor and Processor (GRIDSMART)  
The GRIDSMART Bell camera is a fisheye camera that is pole-mounted at an elevated position and pointed down to the road surface. The main benefit of the fisheye camera is that it covers a large area in a single distorted image. However, the further from the camera, the larger the distortion, which leads to lower performance in detection and localization results. Therefore, two GRIDSMART cameras are installed on the SW and NE mast arm at the State Street and Main Street. The GRIDSMART will stream the raw image data to the roadside computational device for real-time perception tasks.
2. RSU  
Two Cohda MK5 DSRC RSUs and one Cohda Cellular MK6C RSUs are installed at the roadside. The RSUs are functional for Immediate Forward messaging (IMF), and WAVE Short Message Forwarding (WSMF) for any type of message communication defined in SAE J2735\_201603.
3. Traffic Signal Controller (Econolite COBALT Controller)  
Firmware supports broadcasting SPaT MIB (245 bytes data) and NTCIP 1202 (can send force-off, hold etc. control command)
4. NTP server  
The NTP server provides precisely satellite clocks for all roadside infrastructure devices to synchronize their clocks over the Internet within the Mcity traffic network. Both NTP and PTP are supported.

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