UNITED STATES
DEPARTMENT OF TRANSPORTATION

VEHICLE-TO-VEHICLE COMMUNICATIONS FOR SAFETY

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Solving Transportation Issues Through Greater Situational Awareness

Drivers/Operators

Vehicles and Fleets

Connectivity

Infrastructure

Wireless Devices

Opportunity for Safer Driving

- Greater situational awareness
  - Your vehicle can “see” nearby vehicles and knows roadway conditions you can’t see
  - 360 degree “visibility”
- Reduce or even eliminate crashes thru:
  - Driver Advisories
  - Driver Warnings
  - Vehicle Control

Connected vehicles have the potential to address approximately 80% of vehicle crash scenarios involving unimpaired drivers

RESEARCH TOWARDS IMPLEMENTATION

KEY SAFETY PROGRAM OBJECTIVES

- 2013 Decision on Vehicle Communications for Safety (light vehicles)
- 2014 Decision on Vehicle Communications for Safety (heavy vehicles)
- 2015 Infrastructure Implementation Guidance

Remaining Research In Support of 2013 Decision

- Interoperability → standards
  - Data
  - Communications
  - Security
- Driver Clinics
  - User acceptance data
- Model Deployment
  - Safety system effectiveness data
  - Real world operational proof
- Device Certification
- Policy Implementation Issues

Outstanding Technical Issues

- Security
  - Establishing trust relationships
  - Credential management
- Congestion mitigation
  - Ensuring messages arrive when they need to

The DSRC Technology for Safety

- What it is
  - Wi-fi radio product adapted for high speed environment
  - Cheap to produce in quantity
- How the technology works
  - Generates/receives messages at 10 times/sec
    - Basic Safety Message (vehicle size, position, speed, heading, acceleration, brake system status)
  - Operating range of 300 meters (line-of-sight)
- Necessary for crash imminent situations
- Benefits of the technology
  - Reduced Price
  - Less False Alarms → Delayed warnings
  - More Crash Scenarios → Increased performance
    - Can communicate around vehicles and blind intersections
- Drawback of the technology
  - Both vehicles need to be equipped

TRANSIT

SAFETY

TRUCKS

POLICY

SAFETYPILOT

TESTING

TRAFFIC SIGNALS

AFTERMARKET DEVICE

DATA

SECURITY

STANDARDS

SAFETY PILOT - TRYING TO DETERMINE…

- User acceptance
- Safety system effectiveness values
- How the system operates in a real world, concentrated environment
  - Applications
  - Security
- The role that aftermarket devices can play in accelerating benefits

- Questions
  - Do aftermarket devices have the potential for accelerating benefits for safety?
  - If DSRC is mandated for safety, what is the growth potential for this enabling technology? Or is this anticipated to be a niche market for safety only?

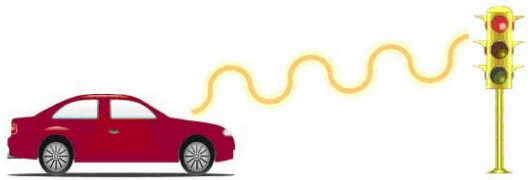
SAFETY APPLICATIONS

V2V

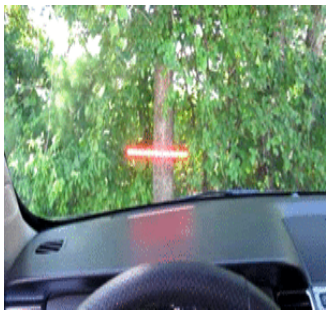
- Forward Collision Warning
- Emergency Electronic Brake Light
- Blind Spot/Lane Change Warning
- Do Not Pass Warning
- Intersection Movement Assist
- Left Turn Assist

V2I

- Curve Speed Warning
- Red Light Violation Warning



Driver Vehicle Interface Examples



CLINIC LOCATIONS

Michigan International Speedway
Brooklyn, MI (Aug 2011)

Brainerd International Raceway
Brainerd, MN (Sept 2011)

VTTI Smart Road
Blacksburg VA (Nov "11)

Alameda Naval Air Station
Alameda CA (Jan 2012)

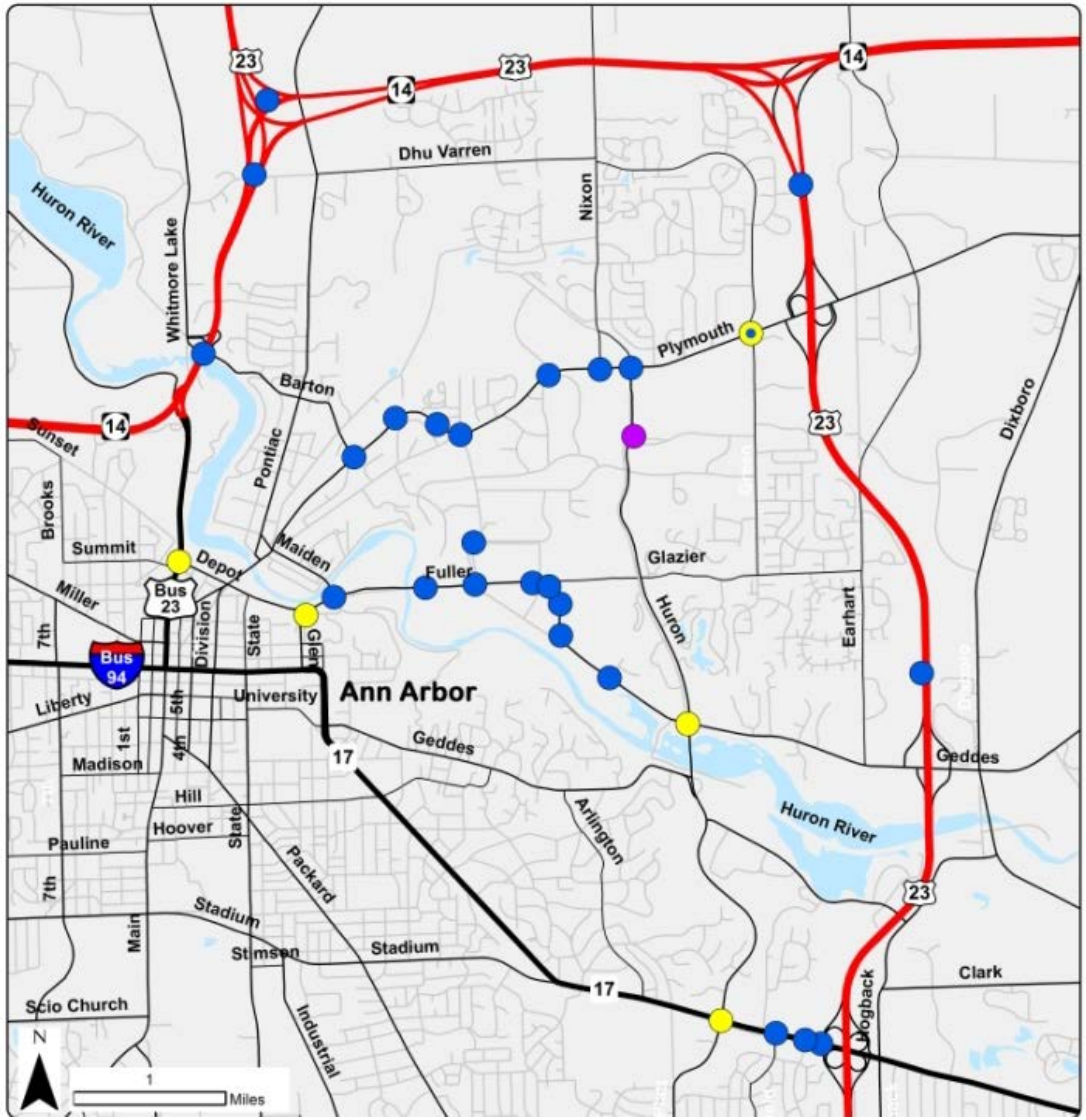
Texas Motor Speedway
Fort Worth TX (Dec '11)

Walt Disney World Speedway
Orlando, FL Oct 2011)

DEPLOYMENT SITE

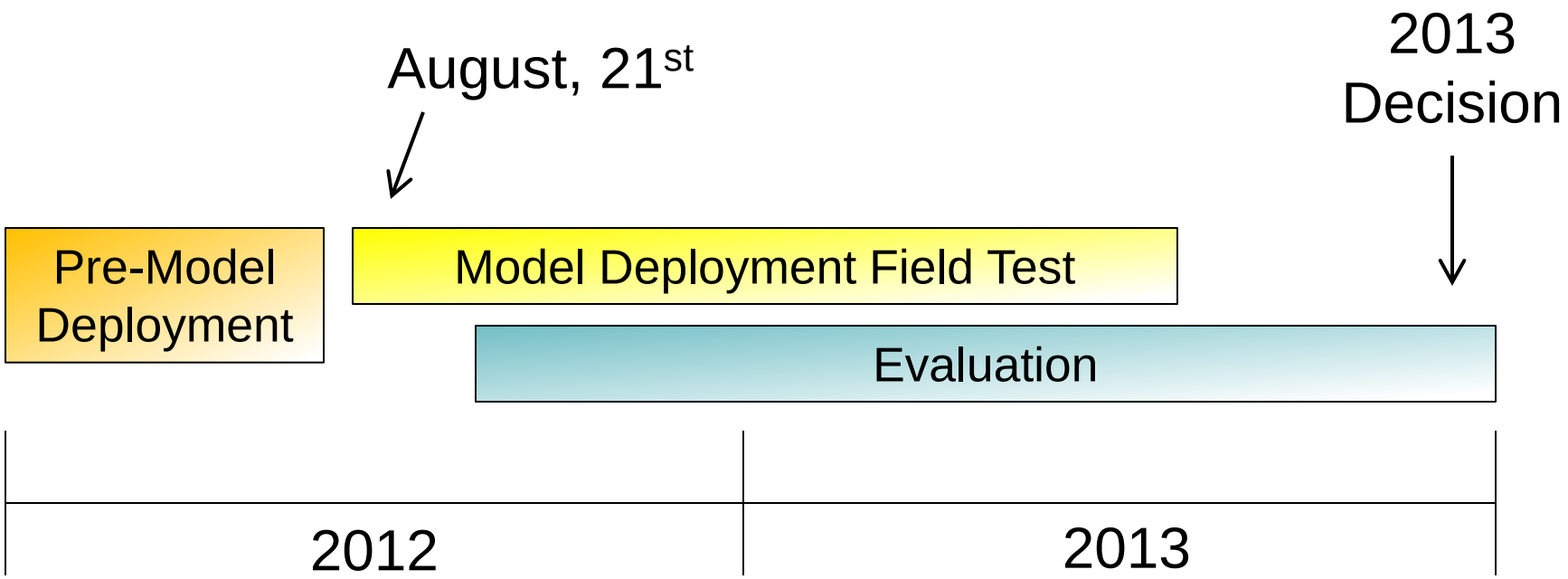
Key Site Elements:
- 75 miles of instrumented roadway
  - 29 roadside units
- ~3000 vehicles
  - -Cars, trucks, buses
  - Integrated, aftermarket, and retrofit
- -1 year of data collection

Also:
- Exercising security options
- Vetting device certification process



Stage II. Safety Pilot Deployment
- Stage I. Radio Installation Location
- Stage II. Radio Installation Location
- Plymouth & Green Stage II. SPaT Radio Upgrade
- UMTRI Service Garage

NHTSA Agency Decision

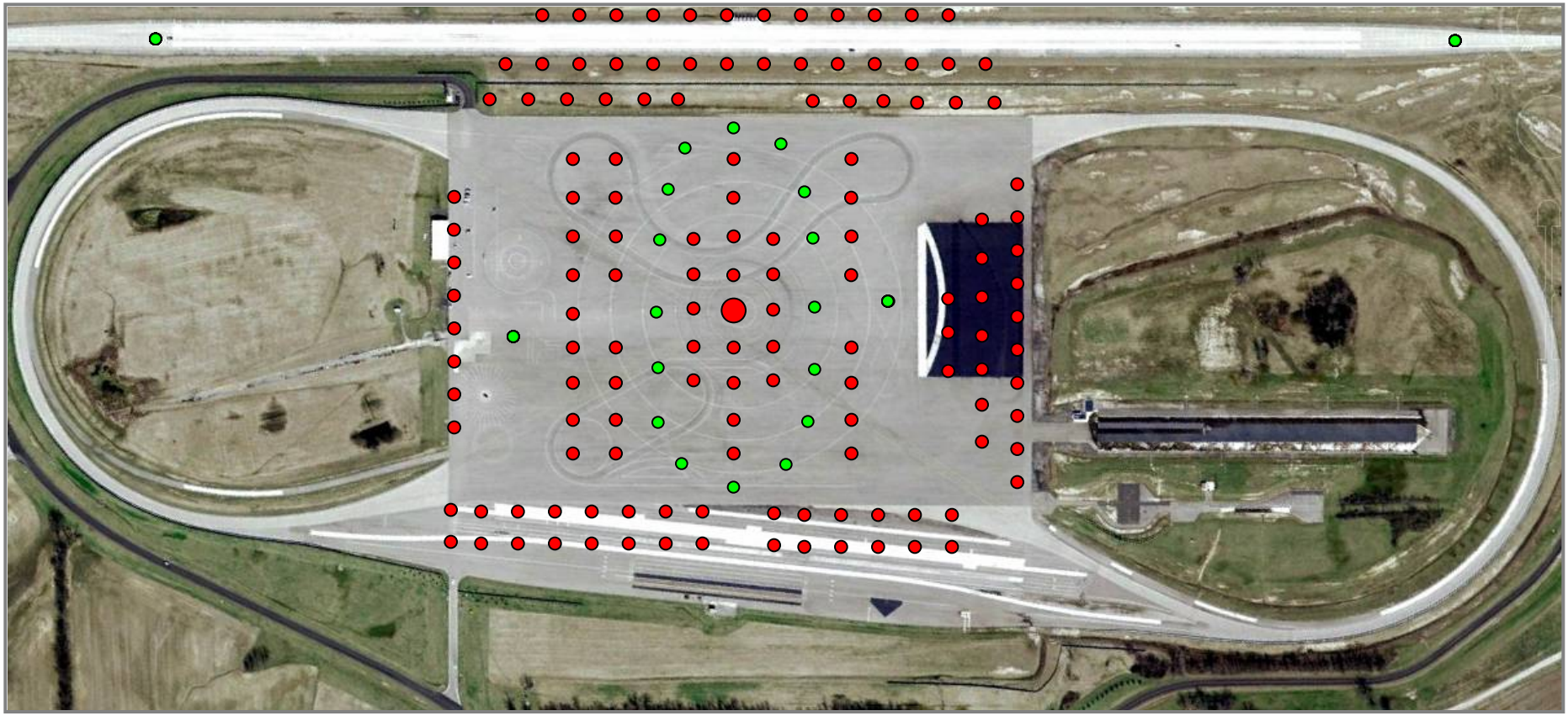


- NHTSA decision will consider all possible options
- Decision will be based on what the data can support

Back up slides

FINALIZING THE V2V RESEARCH SCALABILITY TESTING

- Test with both static (red) and moving (green) vehicles
- Multiple Scaling increments (50, 100, 200+ vehicles)
- Employ congestion mitigation techniques
- Integrate Security Solution



Open Road Performance Testing

Freeway Open Sky

Major Throughway

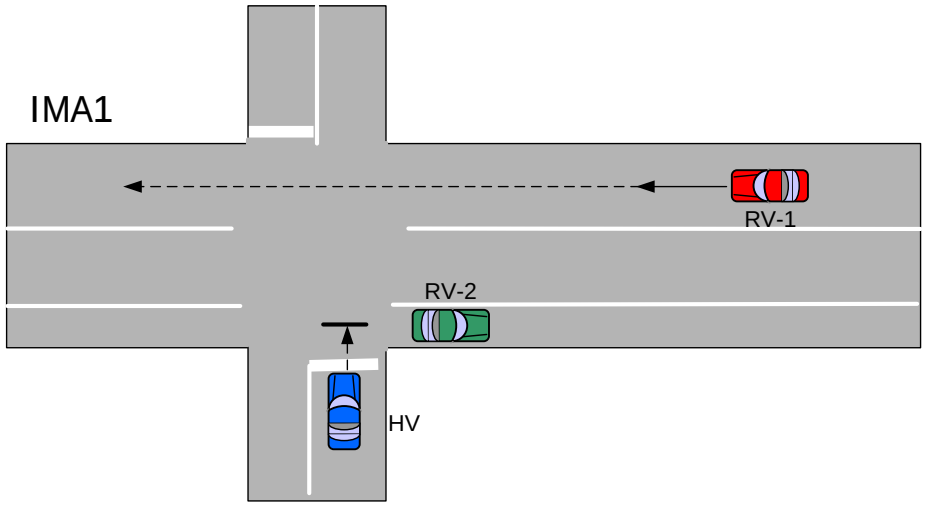
Local Roads – Tree Cover

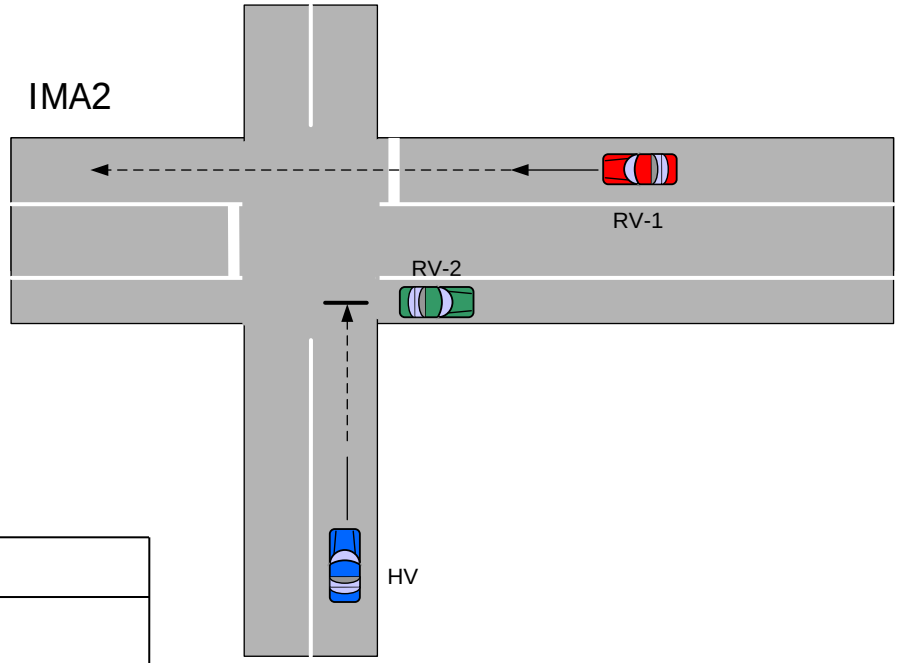
Urban Canyon

Mountainous Terrain

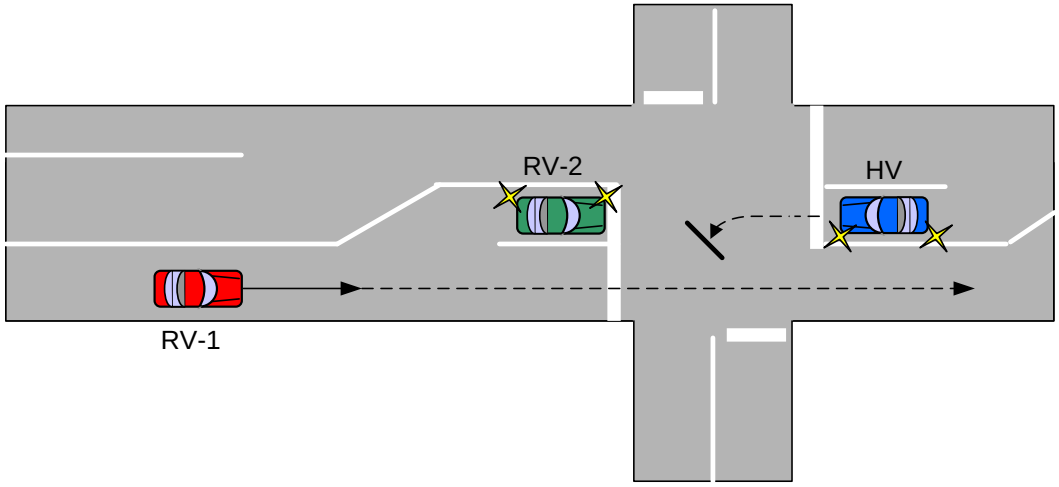
INTERSECTIONS

IMA





LTA



BASIC SAFETY MESSAGE (BSM) FUNDAMENTALS

- Connected V2V safety applications are built around the BSM, which has two parts
  - BSM Part 1:
    - Contains the core data elements (vehicle size, position, speed, heading acceleration, brake system status)
    - Transmitted approximately 10 times per second
  - BSM Part 2:
    - Added to part 1 depending upon events (e.g., ABS activated)
    - Contains a variable set of data elements drawn from many optional data elements (availability by vehicle model varies)
    - Transmitted less frequently
  - No on-vehicle BSM storage of BSM data
  - The BSM is transmitted over DSRC (range ~1,000 meters)

- **The BSM is tailored for low latency, localized broadcast required by V2V safety applications**