Michigan Connected and Automated Vehicle Working Group

April 11, 2019

Meeting Packet

1. Agenda
2. Meeting Notes
3. Attendance List
4. Presentations

Michigan Connected and Automated Vehicle Working Group

April 11, 2019

Macomb Community College
14500 E. 12 Mile Road, Building K, room K324, Warren, MI 48088

Meeting Agenda

12:30 PM	**Registration and Networking**
1:00 PM	**Introduction and Update** Eric Paul Dennis, Senior Transportation Systems Analyst, CAR
	Macomb Community College Welcome Remarks Robert Feldmaier, Interim Dean, Engineering & Advanced Technology, MCC Director, Center for Advanced Automotive Technology (CAAT)
	Increasing Vulnerable Road User Safety in the Ann Arbor CV Test Environment Mary Lynn Buonarosa, Project Manager, UMTRI
	Connected Vehicle Integration, the "The Last Mile" Jason Furr, Director CV Services and Marketing, Brandmotion
	Macomb County Connected Vehicle Program John Abraham, Director of Traffic and Operations, Joseph Bartus, Traffic and ITS Project Engineer, Macomb County Department of Roads
2:30 PM	**Networking Break**
3:00 PM	**Hot Topics Discussion** Frank Perry, Principal Consultant, CAV Program Manager, WSP
	Bicycle to Vehicle Safety Update Jake Sigal, CEO, Tome Software
	Connectivity for Automotive Technicians Nelson Kelly, Assistant Director, CAAT, Macomb Community College
4:00 PM	**Meeting Adjourned**

Michigan Connected and Automated Vehicle Working Group April 11, **2019**

Meeting Notes

The Spring 2019 meeting of Michigan Connected and Automated Vehicle Working Group was held on **April 11, 2019** and hosted by **Macomb Community College.** The meeting was held at the 14500 E. 12 Mile Road, Building K, room K324, Warren, MI 48088

Eric Paul Dennis, Senior Transportation Systems Analyst, CAR welcomed the Michigan CAV Working Group attendees, reviewed the meeting agenda and mentioned noteworthy CAV (and related) news. Eric also invited Edward Straub, Executive Director at SAE International to provide a brief introduction to the Automated Vehicle Consortium. Within this consortium, SAE has brought together experts from GM, Toyota, and Ford to establish safety and testing principles focused on the safe deployment of SAE Level 4 and 5 automated driving systems. Mr. Dennis also introduced International Alliance for Mobility Testing and Standardization (IAMTS), a global, membership-based alliance of organizations involved in the testing, standardization, and certification of advanced mobility systems and service

Rober Feldmaier, Interim Dean, Engineering & Advanced Technology at Macomb Community College (MCC), also welcomed all attendees to MCC. Mr. Feldmaier spoke about the Macomb County College profile and highlighted MCC's initiatives related to CAV. He also discussed the diverse engineering and advanced technology academic programs that MCC offers. MCC and its 12 partner universities and colleges offer more than 80 academic programs.

Mary Lynn Buonarosa, Project Manager, UMTRI, Spoke about UMTRI's activities for increasing vulnerable road user safety in the Ann Arbor Connected Vehicle Test Environment. Ms. Bounarosa explained the details of UMTRI's Vehicle to Pedestrian research project. According to Ms. Bounarosa UMTRI has installed equipment on 4 midblock crosswalks along Plymouth Rd. in Ann Arbor. The installed equipments include cameras to detect pedestrians, Dedicated Short Range Communication Device (DSRC) roadside units (RSU), cobalt controllers and connected vehicle co-processors. They've also installed an aftermarket safety device in each test vehicle which is able to send a pedestrian warning. The system sends warnings to both test vehicles (DSRC-equipped) and pedestrians through a cell phone app.

Jason Furr, Director of CV Services and Marketing, Brandmotion, introduced his company, Brandmotion. Brandmotion is a 13-year old company that produces OEM-based safety products. Jason highlighted the importance of educating the public on in-vehicle safety features. Brandmotion is also part of the team for the U.S. DOT Tampa Connected Vehicle pilot project. Mr. Furr believes having all the suppliers working together from the early start and solve problems together as they come up was one of the key takeaways this project.

John Abraham, Director of Traffic and Operations, and Joseph Bartus, Traffic and ITS Project Engineer, Macomb County Department of Roads (MCDR), presented on Macomb County Connected Vehicle Program. According to Mr. Abraham, MCDR started to build a robust communication network about 10 years ago. With that goal, MCDR team has designed a wireless communication system and also a high capacity backhaul system. At this time, MCDR has redundant links and also 9.7-Gigabit pipelines for the backhaul network, which enables the MCDR to be ready for any communication technology in the near future. Followed by Mr. Abraham's talk, Mr. Bartus started his presentation on the recently started MCDR Connected Vehicle Infrastructure Project. According to Mr. Bartus, the project is funded through FHWA's Congestion Mitigation and Air Quality Improvement (CMAQ) and in that contract MCDR is a subcontractor to Motor City Electric. The project has three phases, and phase 1 recently has started. The project includes installing RSUs at 298 intersections and also several signal controller and firmware upgrades.

After the networking break, **Frank Perry, Principal Consultant, CAV Program Manager, WSP**. Frank provided a view from his ongoing work with the OmniAir Consortium—a group set-up to certify DSRC V2X devices. Work is ongoing to deploy a U.S. national V2X-based ITS system but has been complicated and delayed by various factors.

Jake Sigal, CEO, Tome Software, introduced his start-up company Tome. Tome has partnered with cycling and automotive companies to create bicycle-to-vehicle (B2V) safety products. According to Mr. Sigal, unlike existing cycling products, Tome focuses on communication with a car on the road. Tome's technology works on existing bicycle products for all cyclists. The company is also working on creating cyclists vulnerability maps by using MDOT bicycle crashes statistics.

Nelson Kelly, Assistant Director, CAAT, Macomb Community College, spoke about The Center for Advanced Automotive Technology (CAAT) and programs specifically geared toward Automotive Technicians. Traditional Auto Service Technician Degree programs are adding advanced driver assistance systems safety and security information that address vehicle connectivity. Also, the Vehicle Development Technician Degree that CAAT offers has CAV and IT content that enables students to learn more about connectivity systems.

The meeting adjourned at 4:15.

MDOT maintains a webpage dedicated to its work related to CAV technologies (http://www.michigan.gov/mdot/0,1607,7-151-9621_11041_38217---,00.html). The page includes documents, presentations, and other materials that may be of interest to CAV stakeholders. Meeting packets containing materials (agenda, meeting notes, attendance, and presentation slides) from past Michigan Connected and Automated Vehicle Working Group meetings are also available on this page.

Michigan Connected and Automated Vehicle Working Group

April 11, 2019

Attendance List

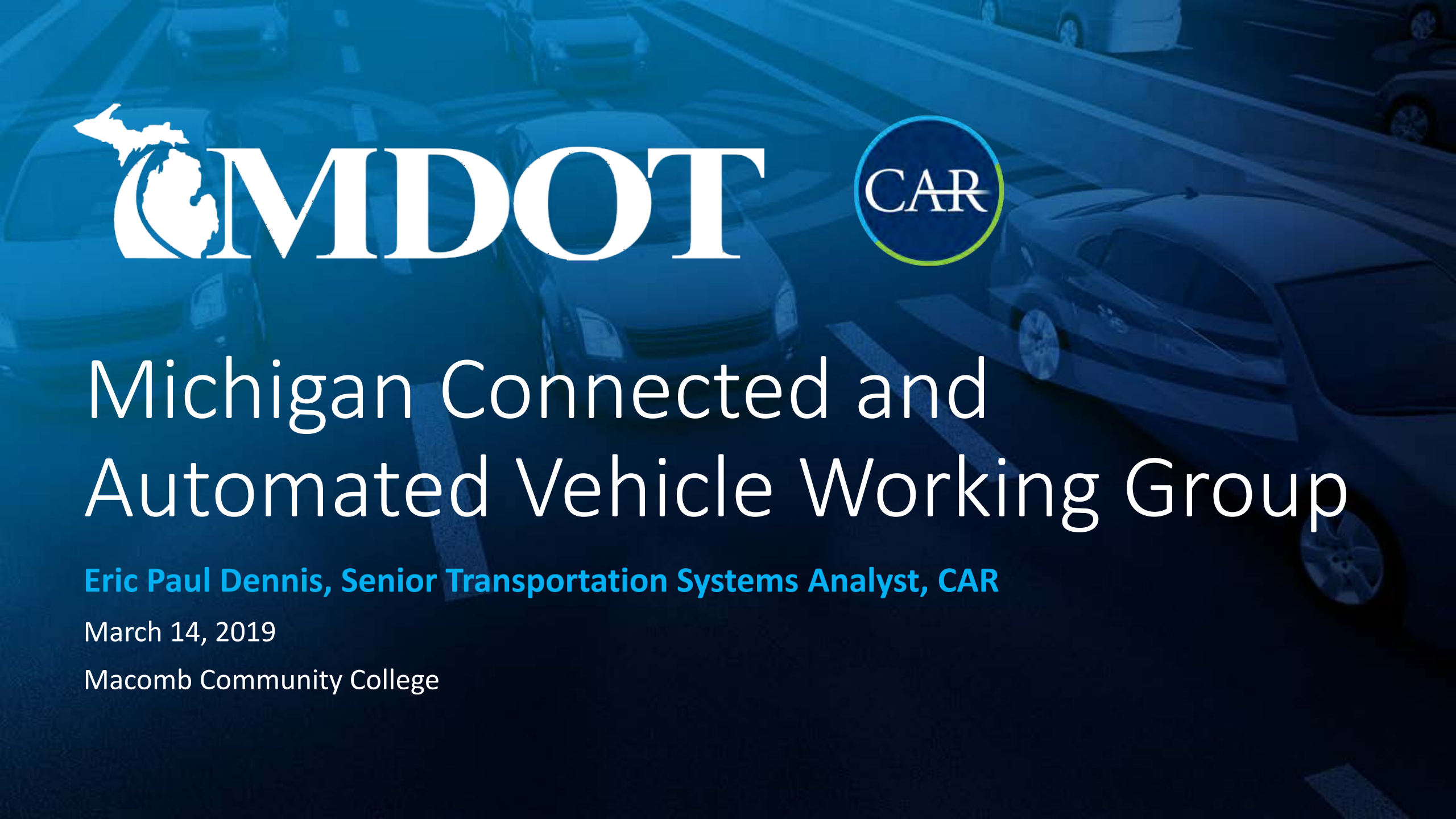
First	Last	Organization	Position
Adam	**Merchant**	Macomb County Department of Roads	Traffic Engineer
Adam	**McArthur**	Atkins Global	Senior Engineer
Ahmad	**Jawad**	Oakland County Road Commission	Signal Systems Engineer/ITS Manager
Bill	**Shreck**	MDOT	Interdepartmental Liason
Camille	**Silda**	Macomb County	Project Manager
Charles	**Parker**	Aptiv	Cybersecurity Lab Engineer
Christyn	**Lucas**	Detroit Regional Chamber	Manager, Business Research
Dale	**Suich**	Independent	Independent
Danielle	**Bowman**	Workforce Intelligence Network (WIN)	Senior Project Manager
Denise	**Donohue**	County Road Assoc. of Michigan	Executive Director
Edward	**Straub**	SAE International	Director
Eric Paul	**Dennis**	Username	Sr. Transportation Systems Analyst

First	Last	Organization	Position
Gary	**Streelman**	Magneti Marelli	Dir Advanced Eng & New Concepts
Henry	**Plachcinski**	Macomb County Department of Roads	Planning Supervisor
Jake	**Sigal**	Tome	CEO
Jasna	**Cehaj**	MDOT	
Jason	**Furr**	Director CV Services and Marketing	Director CV Services and Marketing
Jim	**Ohlinger**	PPG	Manager, Coatings Applications
John	**Abraham**	Macomb County Department of Roads	Director of Traffic and Operations
Joseph	**Bartus**	Macomb County Department of Roads	Traffic and ITS Project Engineer
Ken	**Yang**	AECOM	Senior Systems Engineer
Kenneth	**Barry**	Block Harbor	COO
Kevin	**Kelly**	American Center for Mobility	Technical Sales Manager
Kirk	**Ulery**	Aptiv	Product Line Manager - HSCA
Mark	**Davids**	Education Network for CAV	Board of Directors
Mary Lynn	**Buonarosa**	UMTRI	Project Manager
Massimo	**Baldini**	Tome Software	President
Mia	**Silver**	Macomb County Department of Roads	Project Engineer
Nivas	**Dammalapati**	Atkins	Project Director
Richard	**Allen**	Bosch	Marketing Manager
Richard	**Beaubien**	Beaubien Engineering	Managing Director

First	Last	Organization	Position
Robert	**Feldmaier**	Macomb Community College	Dean - Engineering & Advanced Technology
Ronan	**O'Neil**	DMI	Business Development Director
Stephen	**Selander**	Selander Law Office, PLLC	Attorney
Steven	**Puuri**	Puuri Engineering, LLC	Managing Director
Ted	**Sadler**	Integral Blue	ITS Systems Engineer
Terrence	**Hicks**	Metro Strategies, Inc	Managing Principal
Tom	**Richer**	MDOT	ITS Engineer
Valerie	**Sathe Brugeman**	CAR	Assistant Director
Wayne	**Snyder**	NextEnergy	Director Technology Development
Zahra	**Bahrani Fard**	CAR	Transportation Systems Analyst

Michigan Connected and Automated Vehicle Working Group

Presentations



Michigan Connected and Automated Vehicle Working Group

Eric Paul Dennis, Senior Transportation Systems Analyst, CAR

March 14, 2019

Macomb Community College

Meeting Agenda

1:00 PM **Introductions and Update**
Eric Paul Dennis, Senior Transportation Systems Analyst, Center for Automotive Research

Macomb Community College Welcome Remarks
Robert Feldmaier, Interim Dean, Engineering & Advanced Technology, Macomb Community College

Increasing Vulnerable Road User Safety in the Ann Arbor CV Test Environment
Mary Lynn Buonarosa, Project Manager, UMTRI

Connected Vehicle Integration, the "The Last Mile"
Jason Furr, Director CV Services and Marketing, Brandmotion

Macomb County Connected Vehicle Program
John Abraham, Director of Traffic and Operations,
Joseph Bartus, Traffic and ITS Project Engineer,
Macomb County Department of Roads

2:30 PM **Networking Break**

3:00 PM **Hot Topics Discussion**
Frank Perry, Principal Consultant, CAV Program Manager, WSP

Bicycle to Vehicle Safety Update
Jake Sigal, CEO, Tome Software

Connectivity for Automotive Technicians
Nelson Kelly, Assistant Director, CAAT, Macomb Community College

4:00 PM **Meeting Adjourned**
Tour of Center for Advanced Automotive Technology at Macomb Community College

Working Group Mission

Cooperatively pursue projects and other activities that are best accomplished through partnerships between multiple agencies, companies, universities, and other organizations and that ultimately advance Michigan's leadership position in connected and automated vehicle research, deployment, and operations.

Goals

- Benefit our state and our industry (automotive and more)
- Enhance safety and mobility in Michigan and beyond

Upcoming CAV Events

- **2019 Washington D.C. Auto Show**
  April 5-14, 2019 | Walter E. Washington Convention Center, Washington, D.C.
- **SAE WCX World Congress Experience**
  April 9-11, 2019 | Cobo Center, Detroit, MI
- **2019 Innovative Vehicle Design Challenge**
  May 11, 2019 | Kettering University GM Mobility Research Center, Flint, MI
- **Next Gen Mobility Summit**
  May 23-24, 2019 | Santa Clara, CA
- **TU-Automotive Detroit 2019**
  June 4-6, 2019 | Suburban Showcase, Novi, MI
- **Others?**

Announcements

SAE INTERNATIONAL

SAE ITC
An SAE International Affiliate

Automated Vehicle Safety Consortium™
A Program of SAE ITC

To establish safety and testing principles focused on the safe deployment of SAE Level 4 and 5 automated driving systems

TOYOTA

Ford

GM

iamts™
International Alliance for Mobility Testing and Standardization
A Program of SAE ITC

A global, membership-based alliance of organizations involved in the testing, standardization, and certification of advanced mobility systems and service

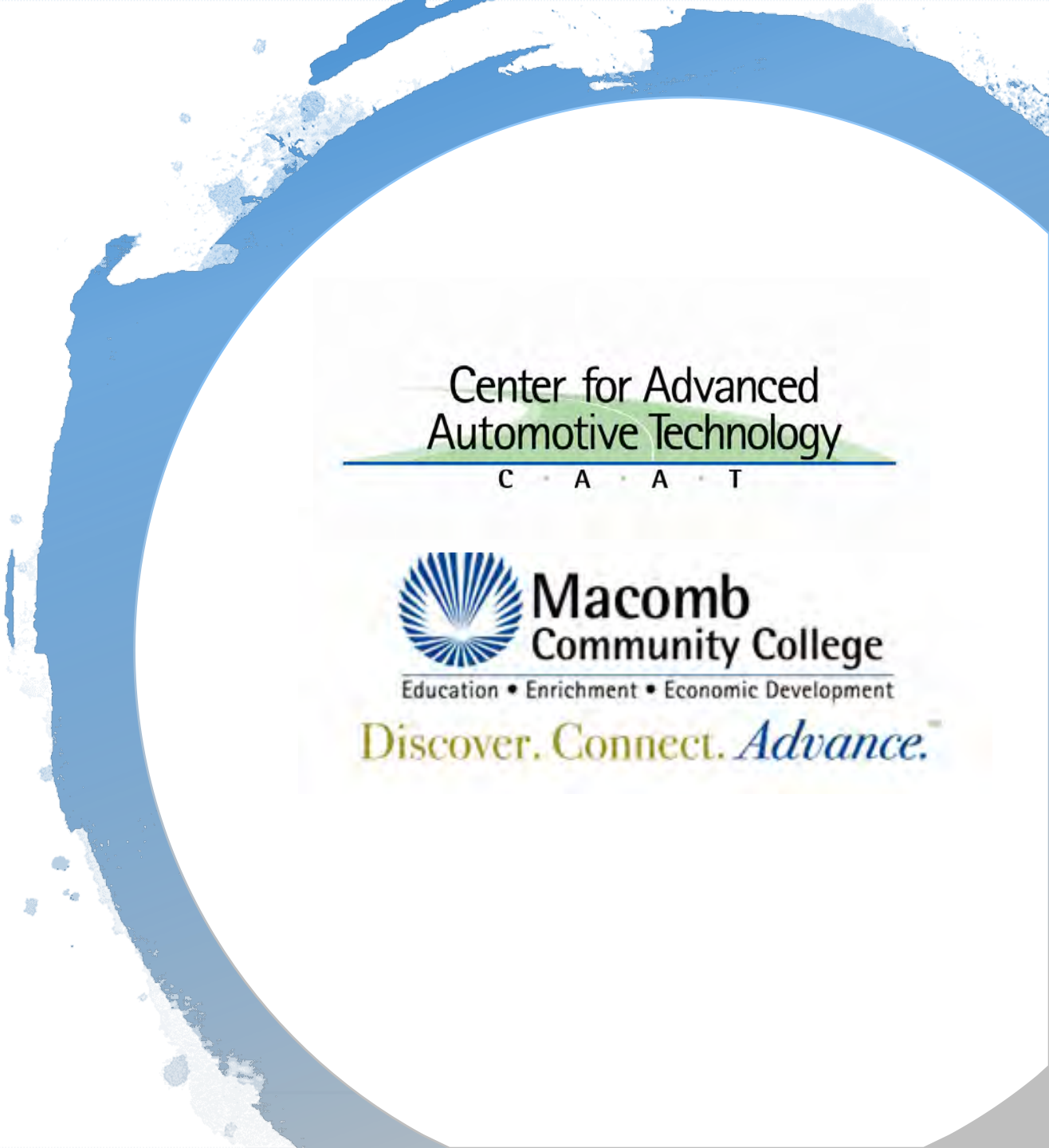
TÜV SÜD

CATARC

安亭·上海国际汽车城
Anting · Shanghai International Automobile City

iTiC

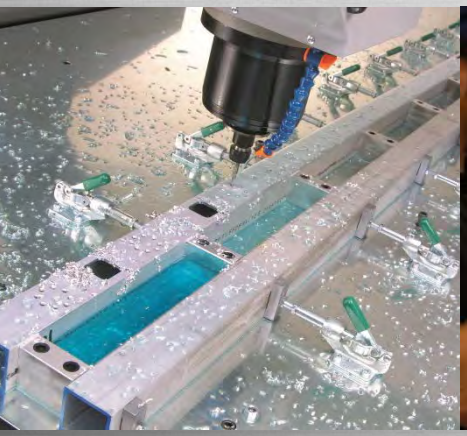
Thank you to our hosts!



Macomb Community College

Engineering & Advanced Technology Department

CAR CAV Meeting—April, 11 2019




Macomb Community College

Macomb Community College
Education • Enrichment • Economic Development
Discover. Connect. *Advance.*

- 3 campuses
  - South
  - Center
  - East
- M-TEC
- 418 acres
- 42 buildings

College Profile

Macomb Community College
Education • Enrichment • Economic Development
Discover. Connect. *Advance.*

- Largest grantor of associate degrees in Michigan, top 3% in U.S.
- 200 degree and certificate fields
- More than 19,000 degree-credit students each semester
- 12,000 students each year in workforce development, customized training, continuing education

Institutional Priorities

Macomb Community College
Education • Enrichment • Economic Development
Discover. Connect. *Advance.*

- Student Success
- Community Engagement
- Efficiency and Effectiveness

University Center

Macomb Community College
Education • Enrichment • Economic Development
Discover. Connect. Advance.

- 12 partners offer 80+ programs

- Baccalaureate, graduate and professional education programs

Engineering & Advanced Technology

Academic Programs (Degrees and Certificates)

Macomb Community College
Education • Enrichment • Economic Development
Discover. Connect. *Advance.*

Engineering:

- Architectural Technology
- Automated Systems
- Automotive Technology
- Building Construction
- Civil Technology
- Climate Control Technology
- CNC Machining
- Construction Technology
- Digital Sculptor
- Electronic Engineering Technology
- Maintenance Technology
- Manufacturing Engineering
- Manufacturing Technology
- Mechatronics
- Pre-Engineering
- Product Development
- Quality Technology
- Renewable Energy
- Welding

Design:

- *Architectural Technology*
- *Digital Sculptor – Product Development*
- *Information Technology – Website Programming*
- *Media and Communication Arts – 3D Animation*
- *Media and Communication Arts – Collaborative Media*
- *Media and Communication Arts – Creative Imaging and Illustration*
- *Media and Communication Arts – Design and Layout*
- *Media and Communication Arts – Interactive Web Media*
- *Media and Communication Arts – Photographic Technologies*
- *Media and Communication Arts – Video Production*
- *Product Development*

Engineering & Advanced Technology

Non-Academic Credit, Workforce & Continuing Education Programs

Macomb Community College
Education • Enrichment • Economic Development
Discover. Connect. Advance.

Academic Programs (Degrees and Certificates)

Workforce and Continuing Education Programs

- Automated Systems Pathway
- Builder's Pre-License
- Computer Aided Design
- CNC
- Construction: Builder's Pre-License (Segment 1 & 2) Certificate
- Control Robotics Technician
- Home Inspection
- Instructor/Instructional Designer
- Landscape Design
- Mold – Skilled Technician
- Production Operator
- Multi-Skilled Technician
- Quality Control Technician
- Project Management Certificate
- Quality and Lean Management
- Renewable Energy Technology
- Welding
- Workplace Computing

Transfer Pathways

- Drafting and Design
- Quality

Macomb Community College

Engineering & Advanced Technology Department

CAR CAV Meeting—April, 11 2019

Increasing vulnerable road user safety in the Ann Arbor Connected Vehicle Test Environment

Mary Lynn Buonarosa
Project Manager
UMTRI

UMTRI's Roots in Connected Vehicles

SAFETYPILOT

SPMD Launched
August 21, 2012 1:00.00 PM

AACVTE Transition started
May 11, 2015

Connected Vehicle Investment in Ann Arbor

SPMD: $30.3M

- $25.5 M Federal Funds
- $4.8 M Cost Share
  - University of Michigan ($3.9M)
  - MEDC ($450K)
  - MDOT ($300K)
  - Program Partners ($196K)

AACVTE: $15.2M

- $9M in Federal Funds
- $6M Cost Share
  - MEDC ($3M)
  - Mcity ($2.25M)
  - Program Partners and Suppliers ($950K+)

Additional Mcity Investment: $4.4M

- $3.4M Operations and Maintenance
- $150K Green Hills
- $550K Pedestrian Detection
- $287K Expansion of Roadside Equipment and Fiber Network

TOTAL INVESTMENT: $49.9M

AACVTE Deployment

- 74 infrastructure locations:
  - 3 Curve speed warning sites
  - 4 Pedestrian crosswalks
  - 5 Freeway sites
  - 5 Staging/testing sites
  - 57 Intersections
- 2,650 vehicle deployments
  - 1,500 Vehicle Awareness Devices
  - 1,150 Aftermarket Safety Devices
- 8 Applications

SPMD & AACVTE data

- 70+ TB data collected to date
- 7.4 Million Trips
- 48.3 Million Miles
- 1.7 Million Hours
- 149.7 Billion Records
- .....and growing daily

Pedestrians in Ann Arbor

- Ann Arbor is home to ~45K students
- Ann Arbor is a bike and pedestrian friendly town
- Annual summer Art Fair: ~500K visitors to Ann Arbor over a four-day period
- Seven fall Saturdays/year: >110K football fans in Ann Arbor

Some challenges in Ann Arbor

Pedestrian crashes in Ann Arbor

- 2017: 56 crashes involving pedestrians
  - 0 fatalities
- 2013-2017: 283 crashes involving pedestrians
  - 7 fatalities
- 2015: Ann Arbor made it an official city goal to have zero traffic-related fatalities by 2025

V2P research in Ann Arbor

- 4 midblock crosswalks along Plymouth Rd
- Site details
  - GRIDsmart camera to detect pedestrians
  - Lear, DSRC RSU
  - Econolite cobalt controller
  - Econolite connected vehicle co-processor (CV-CP) card
- Vehicle details
  - Danlaw ASD with pedestrian warning, HMI

Two approaches to pedestrian warnings

- First approach:
  - GRIDsmart system detects pedestrians in the cross walk
  - Information sent to CV-CP card. An algorithm forms a personal safety message (PSM)
  - PSM sent to RSU which will broadcast the PSM to all DSRC-equipped vehicles in the vicinity

Two approaches to pedestrian warnings

- Second approach
  - Survey 200 candidates concerning their walking patterns along Plymouth Rd
  - Select 70 participants who frequently cross Plymouth Rd at midblock crosswalks
  - Selected participants will download a phone application that will connect to the RSU over 4G. As with the first approach, CV-CP card runs an algorithm to generate the PSM
  - RSU broadcasts the PSM

V2P

V2P study: Method

- Baseline and treatment periods
- Baseline: PSMs disabled
- Treatment: PSMs enabled
  - Warnings issued to drivers of ASD-equipped vehicles whenever pedestrians are in crosswalk
- Data analyses:
  - Frequency of vehicles traversing the crosswalk with pedestrians in the crosswalk
  - Examine stopping behavior by ASD-equipped vehicles with and w/o warnings

Questions?

Get Connected!

connectedvehicle@umich.edu

aacvte.org

Connected Vehicle Integration: The Last Mile of Deployment

Jason Furr
Director of Connected Vehicle

April 11, 2019

BRANDMOTION
safer cars today

The Most Trusted Retrofit Safety Brand

- 13 years of **innovation, product leadership** in safety applications
- **OEM-based products** work better, get returned less
- Strong relationships with the **best distributor base** in the industry

SAFETY IS NOT AN OPTION

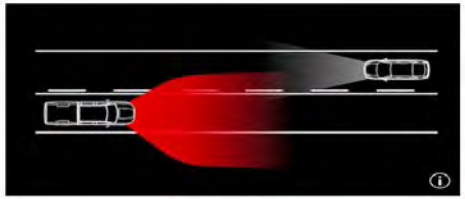
- The US traffic death rate is increasing
- Technology solutions are making vehicles safer
- Retrofit safety products can have biggest impact
- Public education and trust are key

BRANDMOTION
safer cars today

New Vehicle Safety Technology is Proliferating...

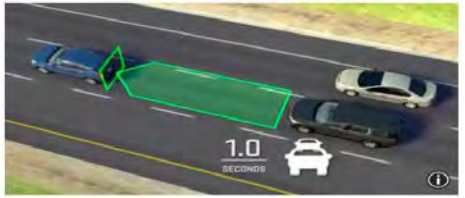
GMC

HD Rear Vision Camera



Available IntelliBeam Headlamps

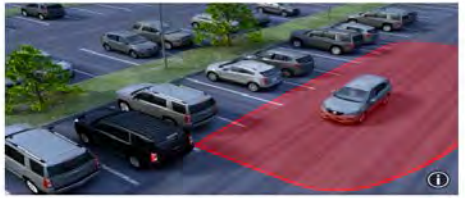
Available Lane Keep Assist with Lane Departure Warning

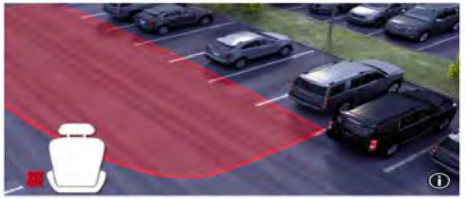


Available Following Distance Indicator

Available Lane Change Alert with Side Blind Zone Alert

Available Forward Collision Alert





Available Safety Alert Seat

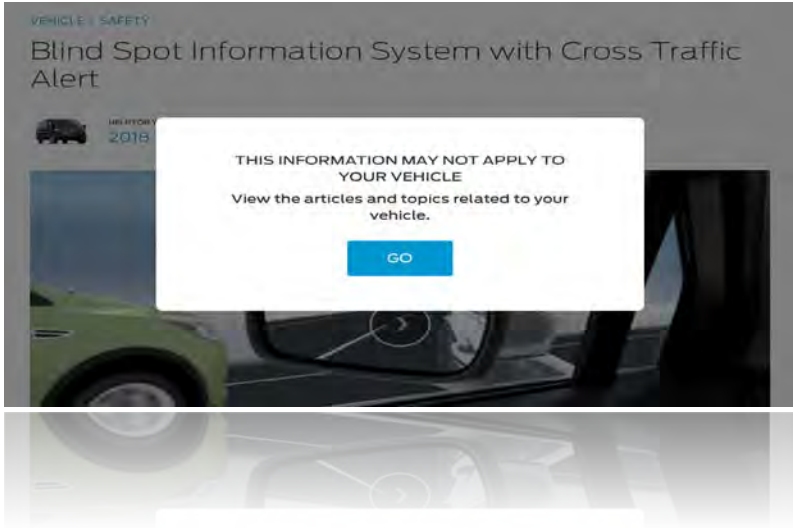
Available Low Speed Forward Automatic Braking

Available Front and Rear Park Assist

...But Not at the Trim Levels Fleets Want

2019 RAM 1500

	TRADESMAN	HFE	BIG HORN	REBEL	LARAMIE	LONGHORN	LIMITED
CAMERA							
ParkView Rear Backup Camera with dynamic gridlines and center lines	S	S	S	S	S	S	S
Surround View Camera (included in Advanced Safety Group, included in M1 Equipment Package) – not available with ParkView Rear Backup Camera	—	—	—	—	P	P	P
FEATURES							
Blind-spot Monitoring with Rear Cross Path detection and Trailer Detection (optional with H2 and X2 Equipment Packages, requires Premium Lighting Group on Medium Price Class; included in P1, P2, and R1 Equipment Packages)	—	—	O	O	P	P	S
Forward Collision Mitigation (Adaptive Emergency Braking) (included in Advanced Safety Group)	—	—	—	—	P	P	P
Lane Departure Warning Plus (included in Advanced Safety Group)	—	—	—	—	P	P	P
PARKING SENSORS							
ParkSense Front and Rear Park Assist with Rear ParkSense Stop (optional with H1 and X1 Equipment Packages; included in H2, X2 and P2 P1 Equipment Packages; it requires fog lamps when offered as LPO)	—	—	O/P	O/P	O/P	S	S
Parallel and Perpendicular Park Assist (Included in Advanced Safety Group)	—	—	—	—	P	P	P



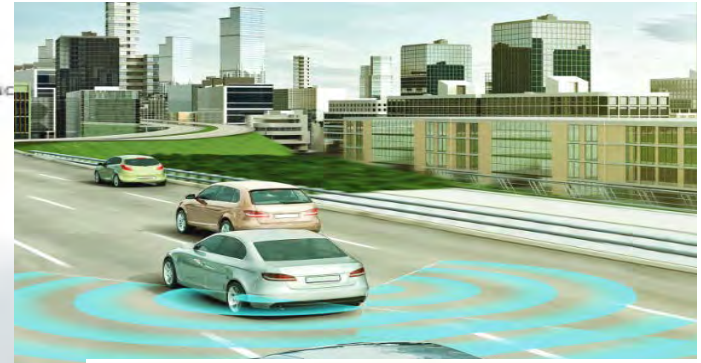
Brandmotion OEM-Grade Radar Blind Spot

“If every vehicle in the US were equipped with RDBS, 50,000 crashes could be prevented” - IIHS

- System does not pick up stationary objects
- Accurately senses the lane next to the vehicle
- Can sense everything from motorcycles to semi truc

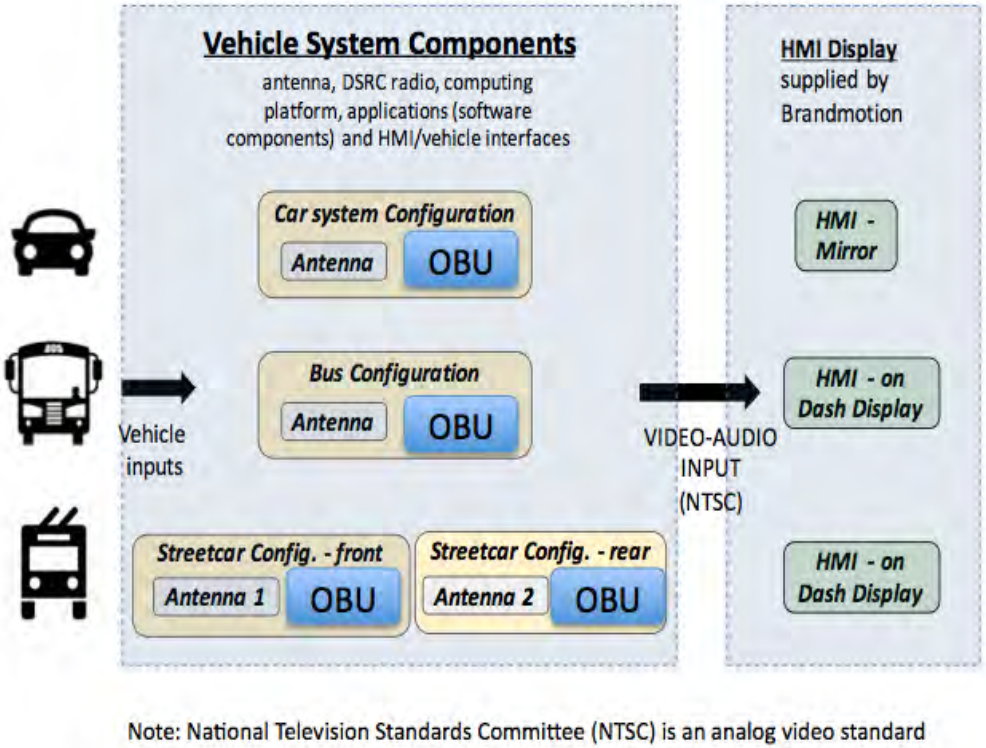
24 Ghz narrow band radars can be tailored to suit any vehicle as an OEM factory-fit

LED indicators cleanly mount at bottom of windshield trim



Connecting the Dots

Applying the concept of bringing safety to vehicles in a faster way we have engaged Connected Vehicle deployments throughout the country…



Note: National Television Standards Committee (NTSC) is an analog video standard

Vehicle System Integrator for the USDOT Tampa CV Pilot

- ***Installed 1048 CV systems*** to date on Tampa roads including buses and streetcars. Established Install time of less than 2 hours for a complex V2X system with a UI on consumer vehicles

- ***Collaborated on key specifications*** over 500 pages of design specs for USDOT. Authored ConOps/System Reqmts, System Architecture & Design, Data Privacy/Mgmt, Installation Plan & Maintenance and Operations Plan and test

- Created a ***common OBU and HMI spec*** for multiple OBU suppliers. OmniAir certification of OBU suppliers and certified third-party security testing

- Launched ***first OTA and secure data mgmt for USDOT pilots.*** Testing completed under actual road conditions, e.g. RSU and OBU comms under high speeds

Vehicle Integrator for CV Pilots

Complete Vehicle System

RSU to Vehicle System Testing

Vehicle System Design and Program Management

- System Component Specifications
- Vehicle specific packaging studies
- OBU procurement, validation and testing
- CAN decoder to obtain signals/data
- Multi-year warranty

Vehicle System Validation

- System testing for interoperability
- Antenna reception testing
- Application technical requirements
- RSU interoperability testing

Vehicle Integrator for CV Pilots

Certified Technicians trained to install complex systems

Tampa Wrong Way Warning "Do Not Enter"

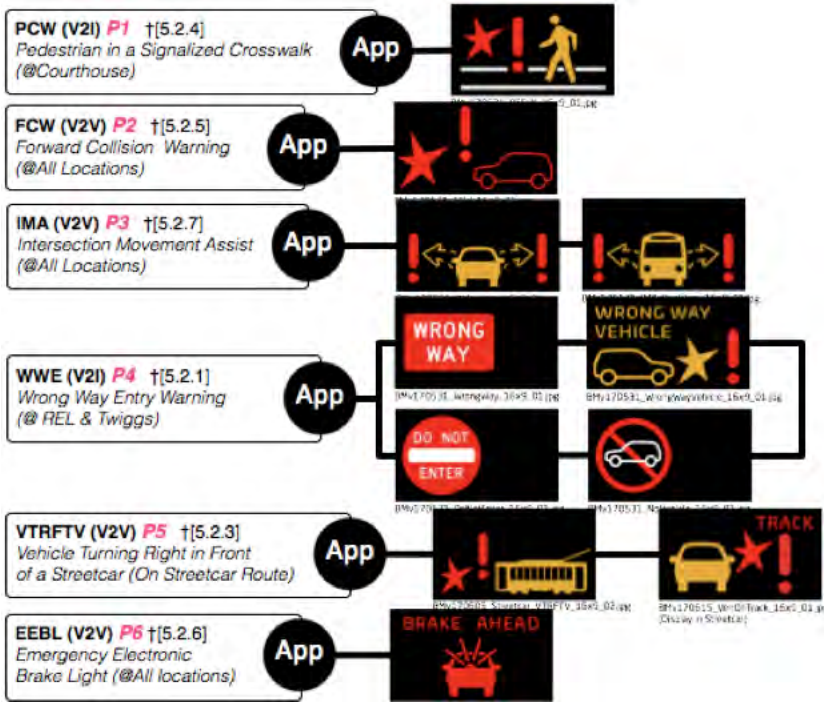
Installation Services & Tech Support
- Scalable installation for large deployments
- Extensive vehicle fitment database
- Nationwide installation team
- End-of-line system testing
- Multi year warranty

User Interface (UI) Design & Development
- ConOp dev., use case design
- Development of software application
- Site-specific application customization
- Driver display and auditory design

Find Ways to Make it Work Better

Developed HMI

- Warnings displayed to driver on a Brandmotion rear view mirror
- Graphics that get driver's attention without distraction
- Functional design of applications



Additional Brandmotion Experience 2018 and 2019

- Vehicle System Installer and wiring provider for the CDOT V2X Deployment Program selected by Panasonic
- Subcontractor for vehicle installation support, allowing PNA to scale installation operations to 100s and then 1000s of vehicles
- Additional installations of over 40 V2X systems on OEM vehicles and in other pilots

Find Ways to Make it Work Better

CAN Decoding Tool

- Saves time at installation by grabbing different signals including turn signals, reverse, brake from CAN BUS
- No splicing of cables needed preventing warranty voidance

CAN Aggregator

- Translate vehicle CAN messages to common spec (CAMP CAN)
- Beneficial for CV deployments when vehicle data is needed
- Adaptable per customer requirements
- No splicing of cables needed preventing warranty voidance

Challenges and Lessons Learned

Real World Pilots with Real Resident Vehicles

Challenges

- Working with the public
- Changing standards
- Loose requirements
- Certifications
- Multiple OBU suppliers
- Multiple RSU suppliers
- Government changes

Lessons Learned

- Brandmotion's strategy for success is early sourcing and partnerships
- Collaborative supplier involvement from the start is key
- Plan for everything to take longer than initially expected


Thank You
BRANDMOTION
safer cars today

Michigan Connected and Automated Vehicle Working Group
April 11, 2019

Macomb County
Ready for Future Mobility

John Abraham, PhD, PE, PTOE
Director of Traffic & Operations
Macomb County Department of Roads
117 South Groesbeck Highway
Mt. Clemens, MI 48043
Phone: 586.493.6701
Fax: 586.463.4266

Macomb County

- Population: 854,769 (third-most populous county in Michigan)
- 27 cities, townships, and villages
- Over 740 traffic signals and 1,700 miles of roads
- Home to:

Ford

GM

U.S.ARMY

CHRYSLER

GENERAL DYNAMICS

AIR NATIONAL GUARD

Circle The Lake Tour

Lake St. Clair

DEPARTMENT OF ROADS

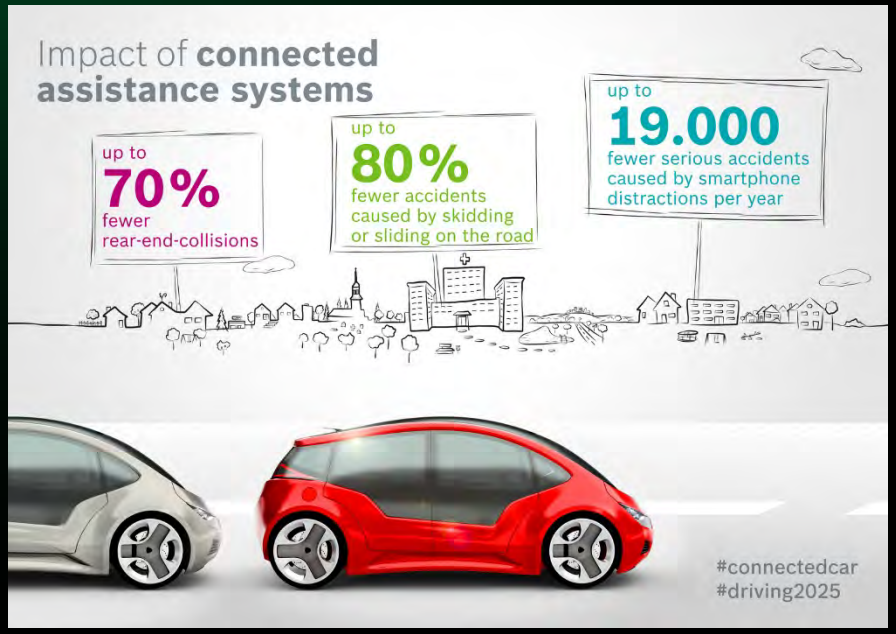
"..dedicated to providing the public with a quality county road system, with a focus on safety and convenience for motorists and the community, environmental responsibility, and financial accountability.."

- Maintains more than 1,700 miles of roads
- Maintains more than 50,000 signs
- Maintains more than 740 traffic signals
- State-of-the-art Traffic Operations Center

Crash Stats 2017 (MSP)

- 314, 921 Total Crashes
- 937 Fatal Crashes
- Macomb County:
  - 25,385 Total crashes/ 41 fatal crashes

Around 37,000 fatal crashes nationwide



0

No Automation

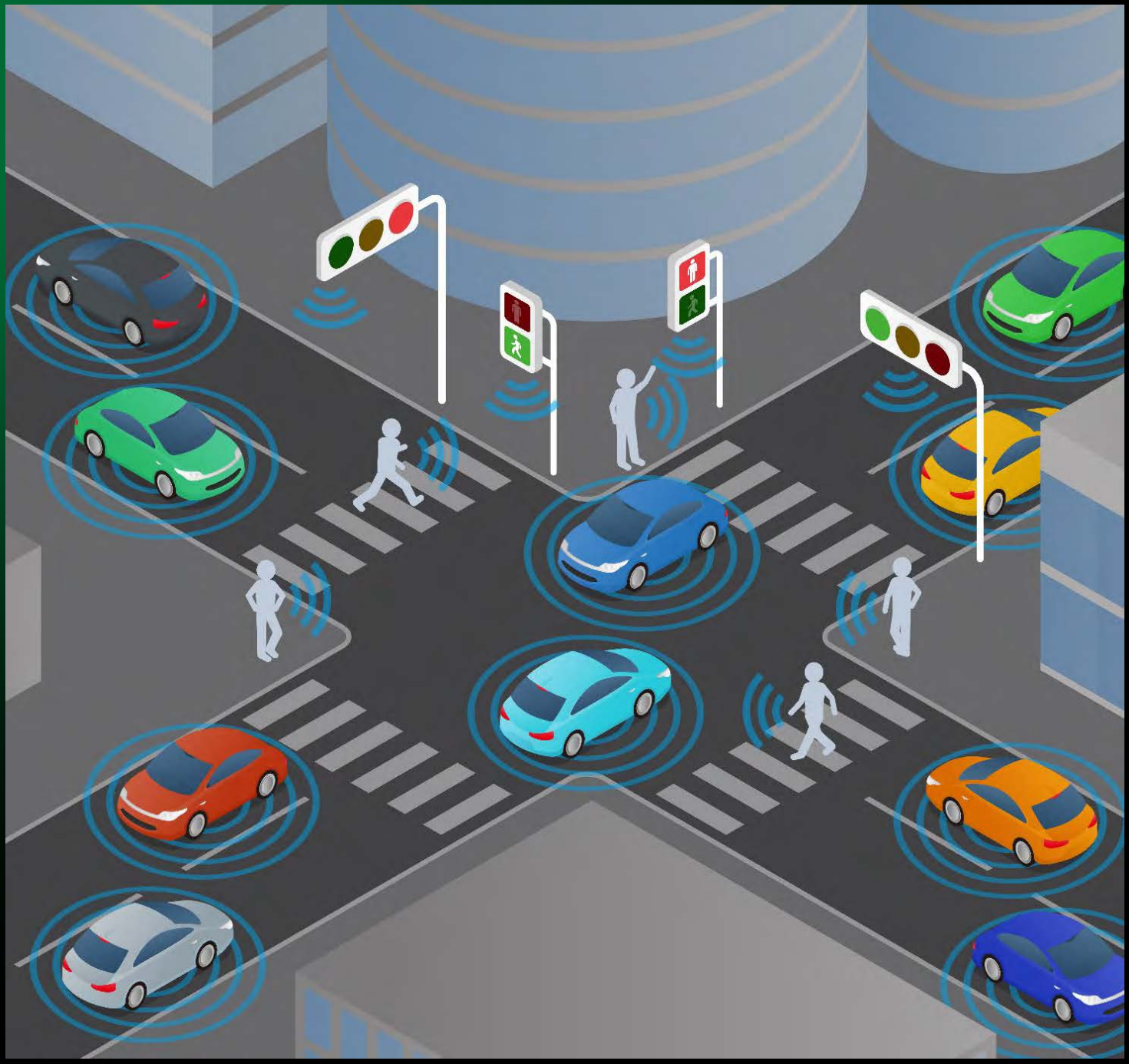
Zero autonomy; the driver performs all driving tasks.

"It's a self-driving car."

5

Full Automation

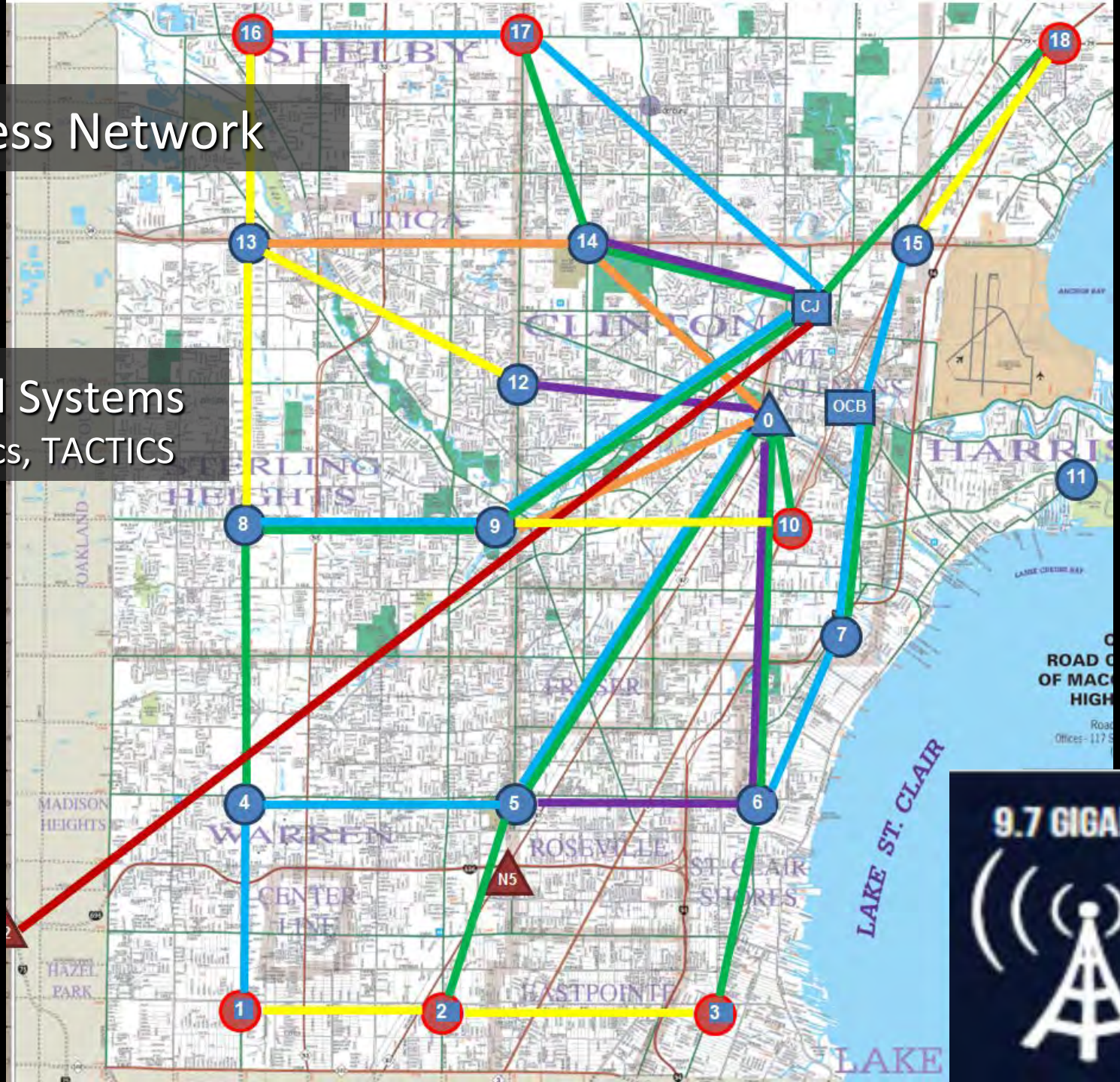
The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.



Wireless Network

Central Systems

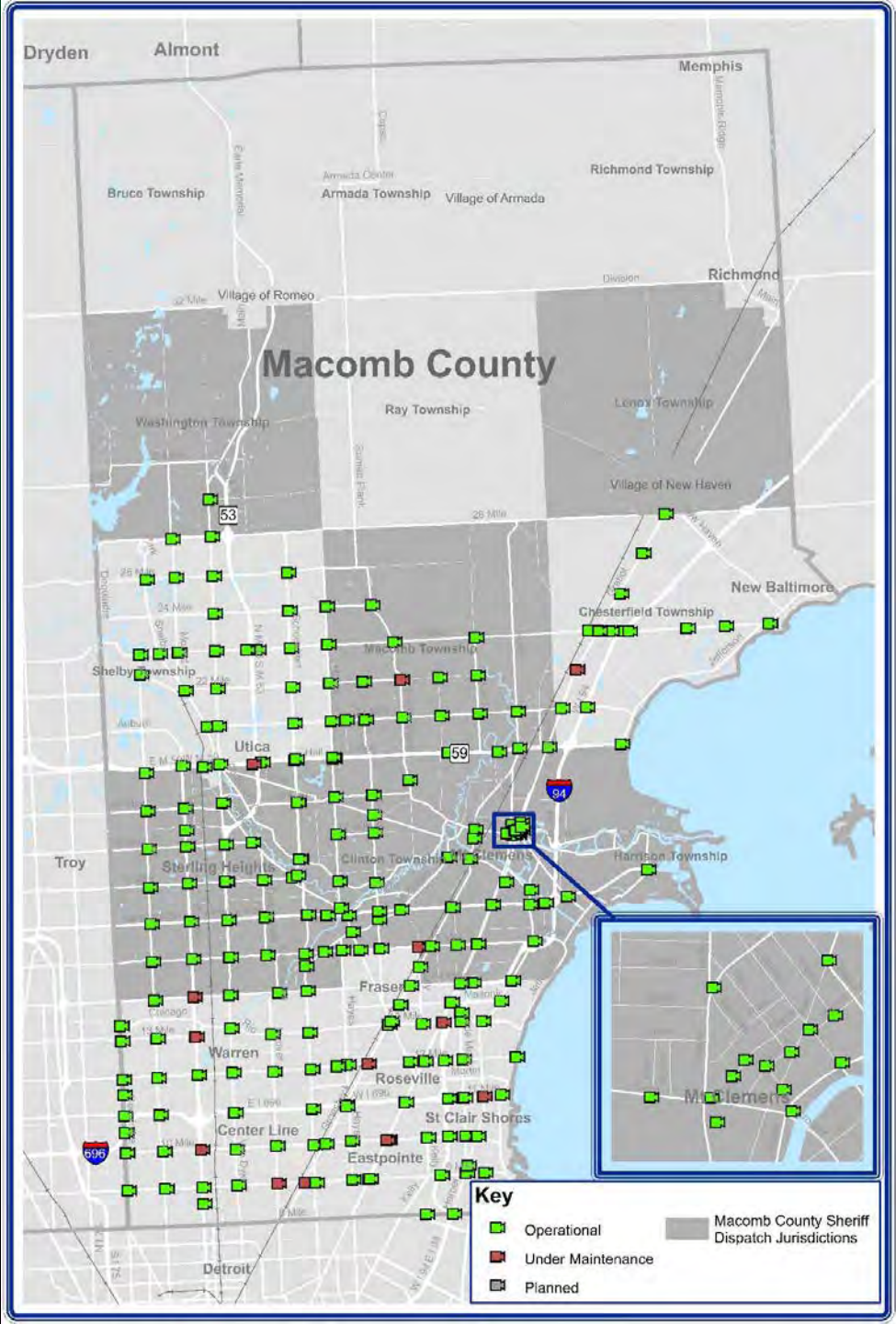
- Centracs, TACTICS



- Modernizing traffic signal locations with Advanced Traffic Signal Controllers
  - Linux base allows for open development of applications

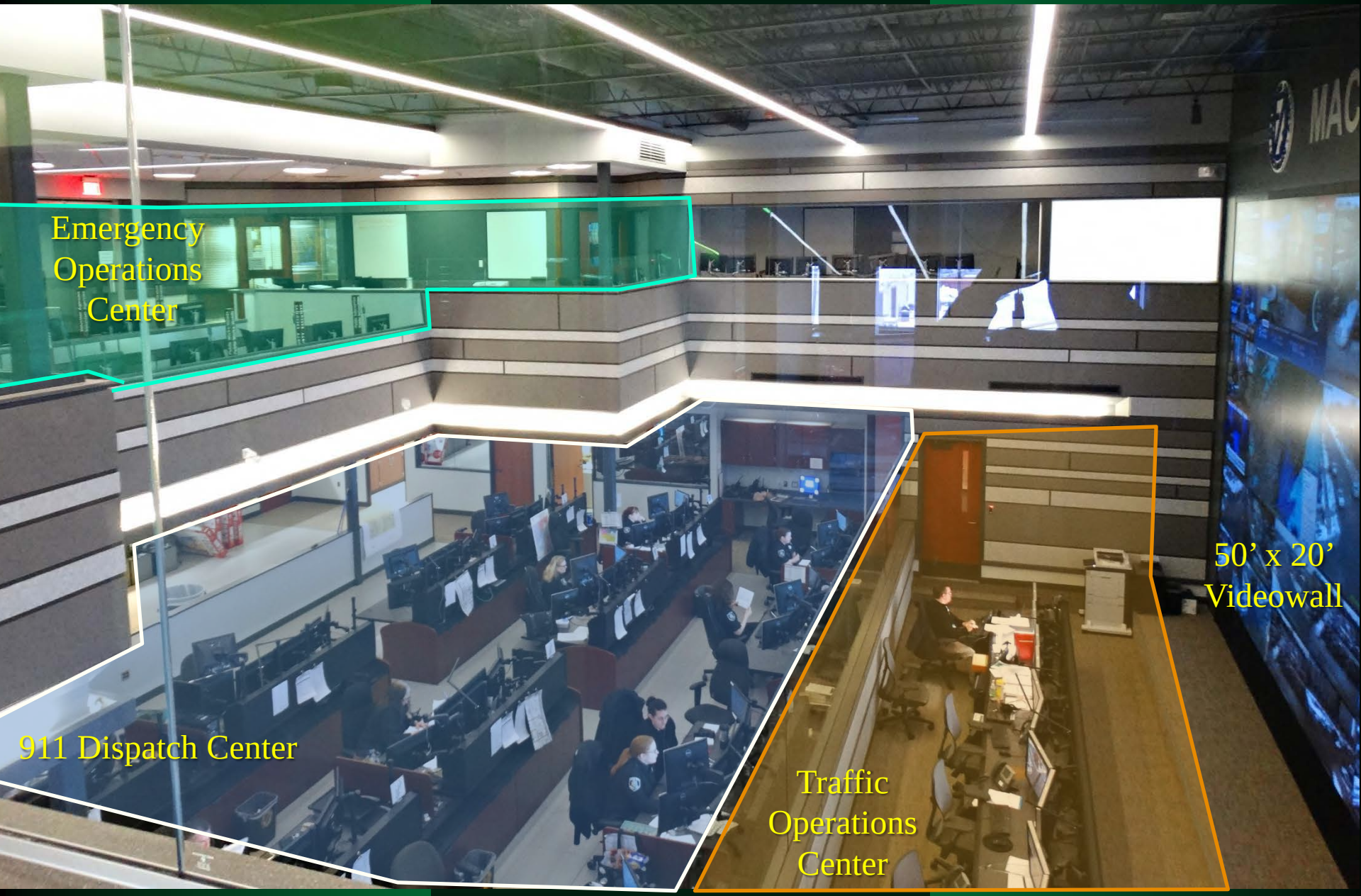
- Adding travel time and speed measuring devices on corridors to provide real-time data
- Central traffic signal software – CENTRACS allows for remote access and real-time signal timing adjustments
- 80 projects over 10 years a majority funded with Federal funds

Camera map

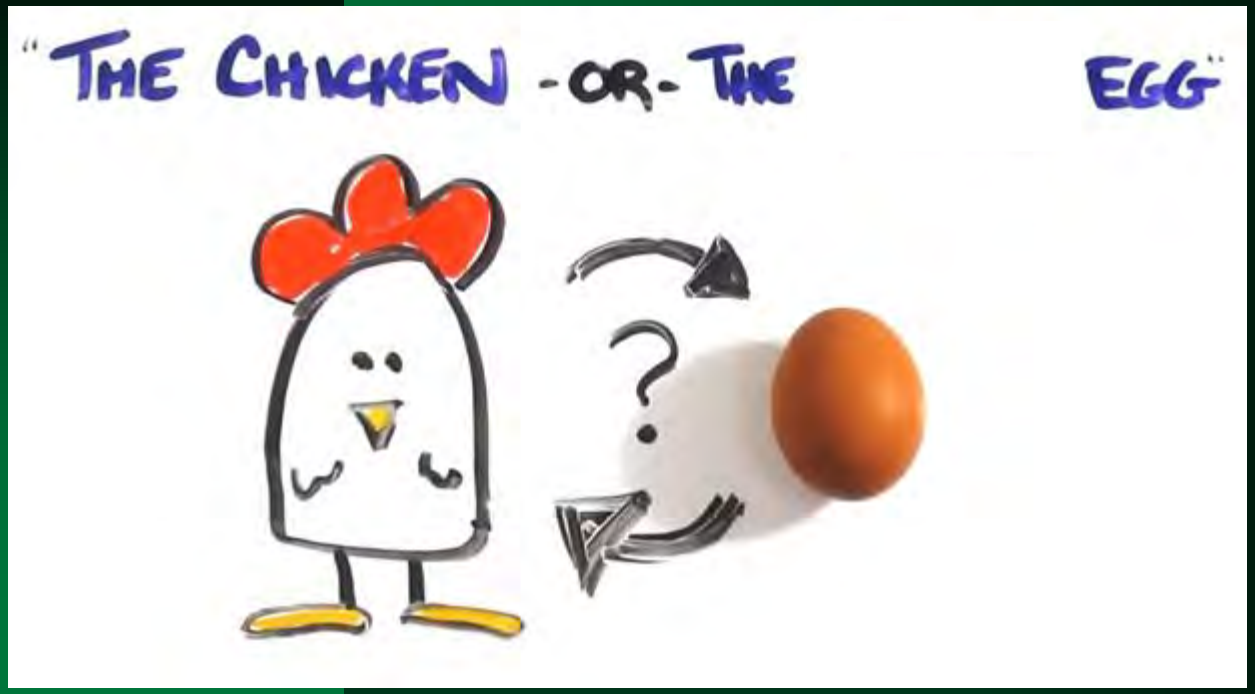

Dryden
Almont
Memphis
Bruce Township
Armada Township
Village of Armada
Richmond Township
Richmond
Village of Romeo
Macomb County
Ray Township
Washington Township
Lenox Township
Village of New Haven
New Baltimore
Chesterfield Township
Shelby Township
Macomb Township
Utica
Troy
Sterling Heights
Clinton Township
Harrison Township
Fraser
Warren
Roseville
St Clair Shores
Center Line
Eastpointe
Detroit
Key
Operational
Under Maintenance
Planned
Macomb County Sheriff Dispatch Jurisdictions

Macomb County COMTEC

- Key Features
  - Video Wall
  - Data Center (fiber ring; 2 backup sites)
  - Eight Traffic Monitoring Positions/Signal Lab
  - Fifteen Dispatch Workstations (expandable to 25)
  - 22 EOC Workstations
  - Generators/UPS
  - Direct Access to 250 + cameras


Emergency
Operations
Center
911 Dispatch Center
Traffic
Operations
Center
50’ x 20’
Videowall


MACOMB COUNTY
MACOMB COUNTY MICHIGAN
MACOMB COUNTY MICHIGAN
DEVELOPING THIS MORNING
MIDDLE EAST IN CRISIS
LIVE
CNN



Our Philosophy : Lets complete the "I" in V2I and become fully connected first, and every connected vehicle that enters the county will be able to take full advantage of this technology. Safer for that vehicle and also for all the motoring public

The Macomb CV Intersection

Potential Applications

- Incident Scene Work Zone Alerts
- Queue Warning
- Transit Signal Priority
- Freight / Snow Plow Signal Priority
- Emergency Vehicle Preemption/Priority
- Mobile Accessible Pedestrian Signal System
- Red Light Violation Warning
- Curve Speed Warning
- Spot Weather Information Warning
- Dynamic Speed Harmonization

DSRC Radio Roadside Unit (RSU)

DSRC

SPaT

COMTEC/TOC
Advanced Traffic Management Systems

Traffic Management System

DSRC Radio On-Board Unit (OBU) Equipped

Traffic Cabinet

Signal Controller

DUAP
MDOT

DATA USE ANALYSIS AND PROCESSING

GM testing smart road tech with MDOT, Macomb Co.

Melissa Burden , The Detroit News Published 11:59 p.m. ET June 20, 2017 | Updated 9:38 a.m. ET June 21, 2017

General Motors Co. is testing a safety feature in Macomb County to warn drivers that traffic signals are about to turn red.

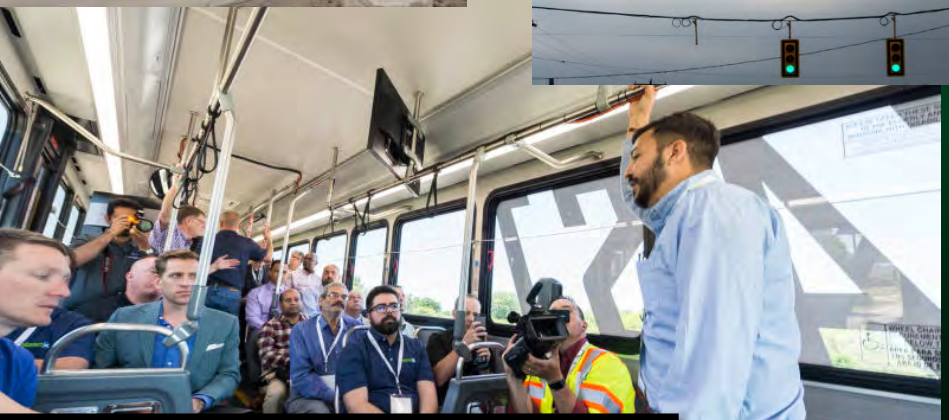
The Michigan Department of Transportation and Macomb County are two of the government units working with carmakers and auto suppliers in testing of the life-saving technology. The state has established at least 100 miles of “connected”

“Smart” traffic signals and sensors in the roadway on Mound at 12 Mile and 13 Mile outside the GM Tech Center in Warren can exchange radio information with Cadillac CTS test sedans equipped with vehicle-to-infrastructure capability. Macomb County installed the equipment at the intersections.

GM DEMO

MDOT ITS SIGNALS CV INITIATIVE

- CV Enabled Signals Policy
- Signal Controller Spec Update
- All new or upgraded traffic signals on the MDOT system will be CV-enabled going forward



SIGNAL PRIORITY and PREEMPTION

- Improving the mobility of transit and first responders/Snow Plows/Freight
- Demo – ITSA Meeting 2018

Where are we with CV?

- Currently almost 60 RSUs installed through various pilots, project and partnerships
- Contractor on board to install 298 RSUs in 2019
- ..and we have been approved for federal grants for all 740 traffic signals in the county connected by end of 2021.

Michigan Connected and Automated Vehicle Working Group
April 11, 2019

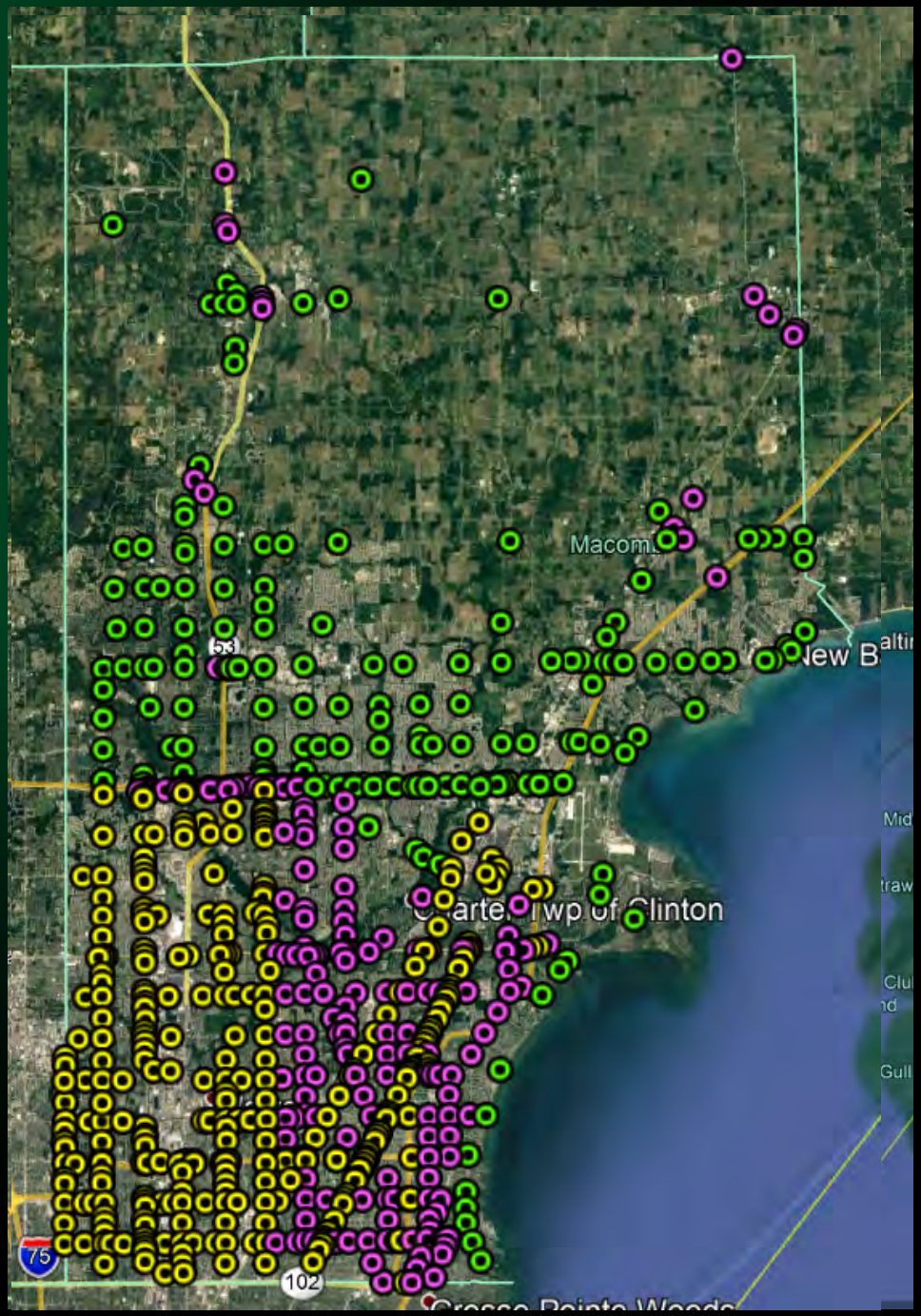
Connected Vehicle Infrastructure: Project Perspective

Joseph Bartus, PE
Traffic & ITS Project Engineer
Macomb County Department of Roads

Phase 1 Facts

- 2018 CMAQ Funded
- September 2018 Let
- Low Bid: $2.8M
- Prime: Motor City Electric
- RSU: Danlaw RouteLink
- 298 Intersections
- 124 of 298 MDOT

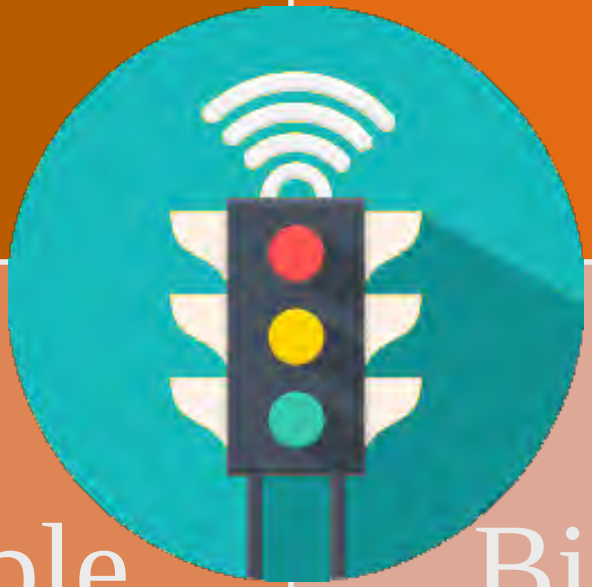
- Phase 2: 179 intersections
- Phase 3: 167 intersections



Project Design (-ables)

Repeatable

Constructible



Spec-able

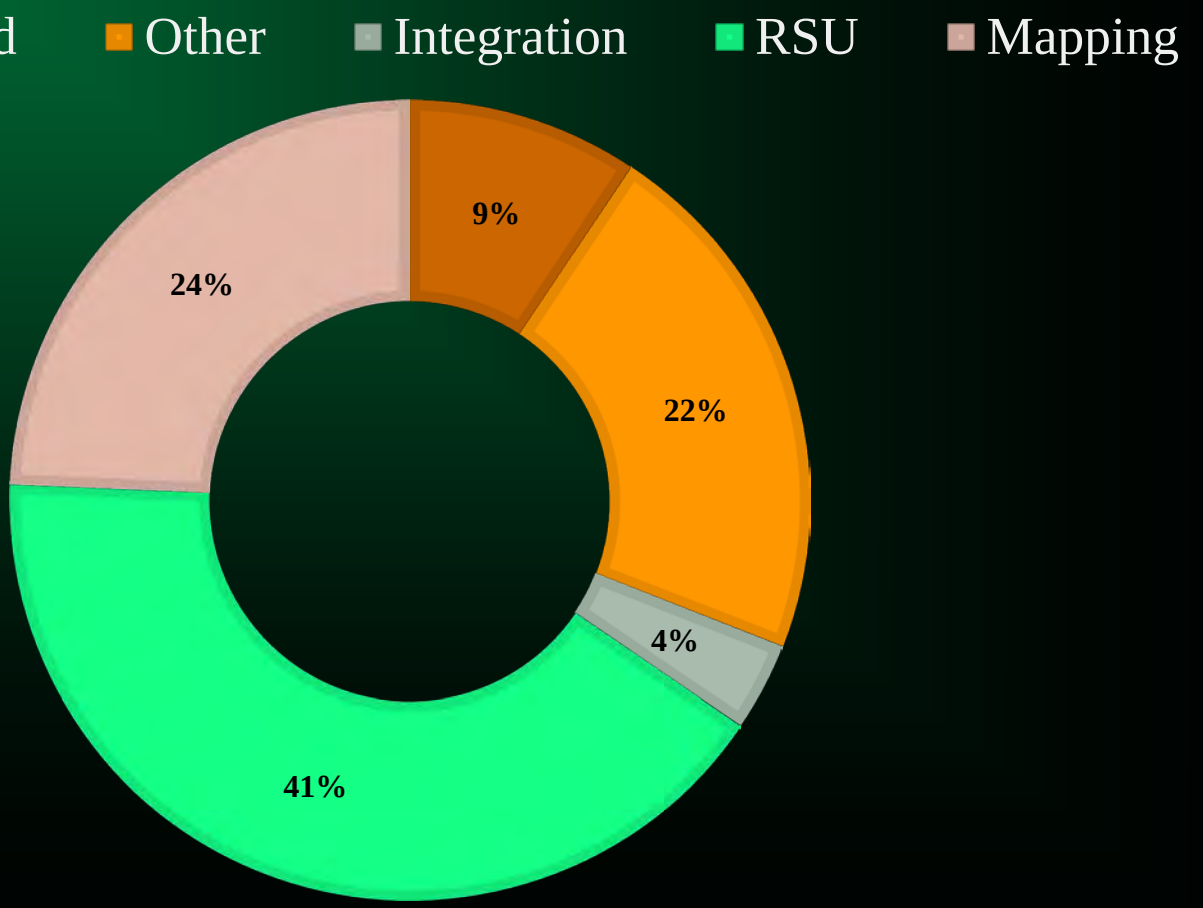
Biddable

ITS Project Structure

The Holy Grail aka RSU

- **DSRC**
- **Central management system**
- **OmniAir Certified**
- **Meet 4.1 or greater**
- **No black box**
- **Support all message sets**
- **BUI/GUI, FCC And more!**

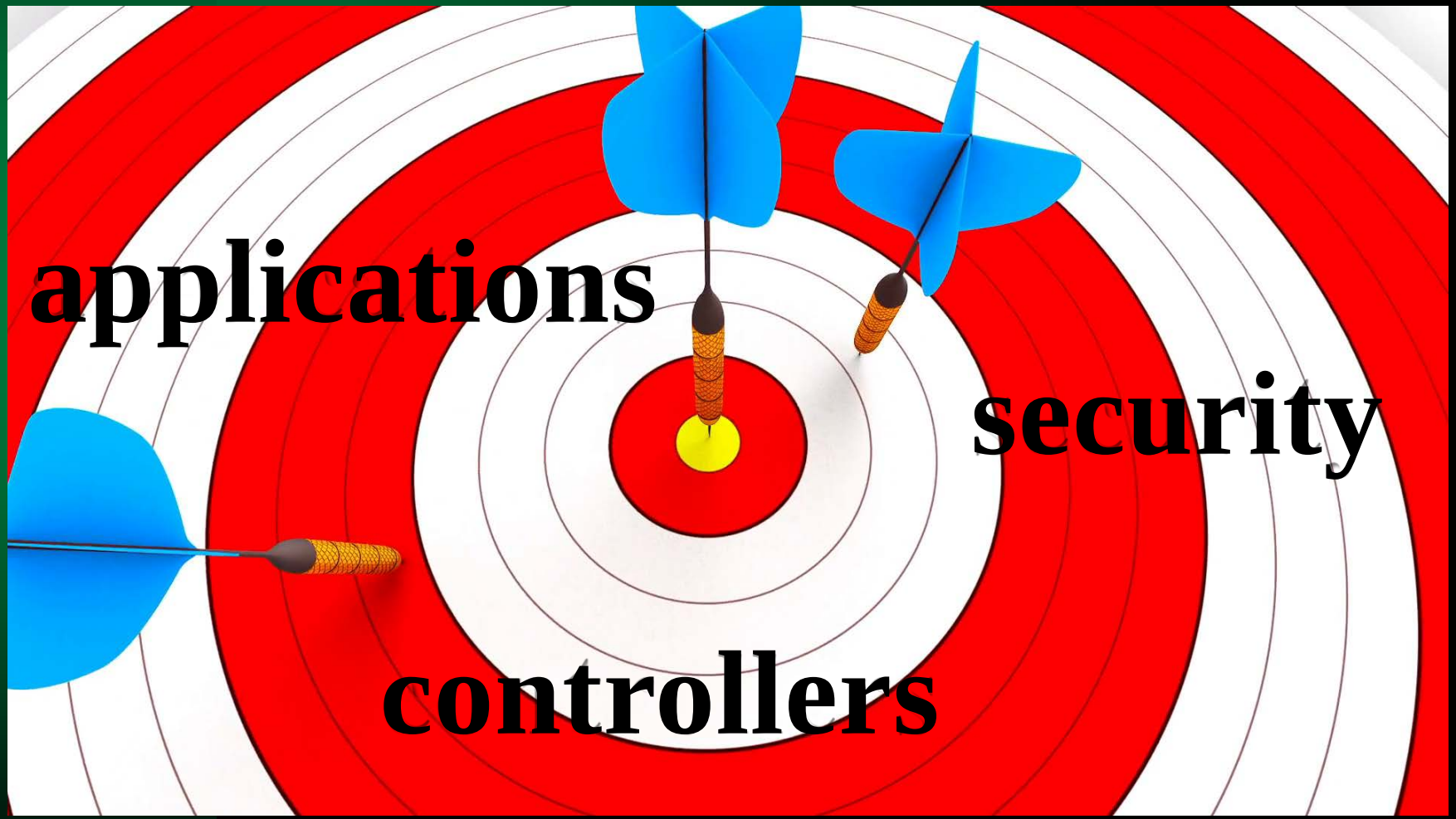
Project Bid Breakdown



Initial Project Challenges

- Project Coordination
- Material Acceptance
- Legacy Signal Equipment

And we have some misses…



Thank you!

John Abraham, PhD, PE, PTOE
Director of Traffic & Operations

Joseph Bartus, PE
Traffic & ITS Project Engineer

Bicycle to Vehicle (B2V)
CAR Update - April 2019

Jake Sigal, CEO

Slides are not available. Please contact Jake Sigal (Jake@TomeSoftware.com) for more info.

Tome

April 11 2019

Vehicle Connectivity for Automotive Technicians

April 11, 2019
Center for Automotive Research
Michigan Connected and Automated Vehicle Working Group

Nelson Kelly
Assistant Director, Energy and Automotive Technology
Center for Advanced Automotive Technology
Macomb Community College
14500 East 12 Mile Road
Warren, MI 48088-3896

The Center for Advanced Automotive Technology (CAAT)

- Located at Macomb Community College, South Campus
- Became an NSF ATE Resource Center in 2018 after ~eight years as a full Center
- Develop and disseminate (for free) curricula in emerging automotive technologies using seed funding
    - 17 completed projects on electric vehicles, lightweighting, CAV, and vehicle testing
    - #18 is Cybersecurity for Automotive Technicians (CAR CAV meeting, 10-25-18)
        - should be completed by the end of June, 2019
    - Just received $1,050,000 grant for three more years
        - will support up to five more new courses through seed funding



Connectivity in Automotive Technology

- What do service technicians learn?

- What do development technicians learn?

The Most Advanced Electronics Course in Automotive Service Technology Associate Degree is AUTO 2410

AUTO 2410 - Advanced Automotive Electronics

2.00 Credit Hours

Macomb Community College Catalog

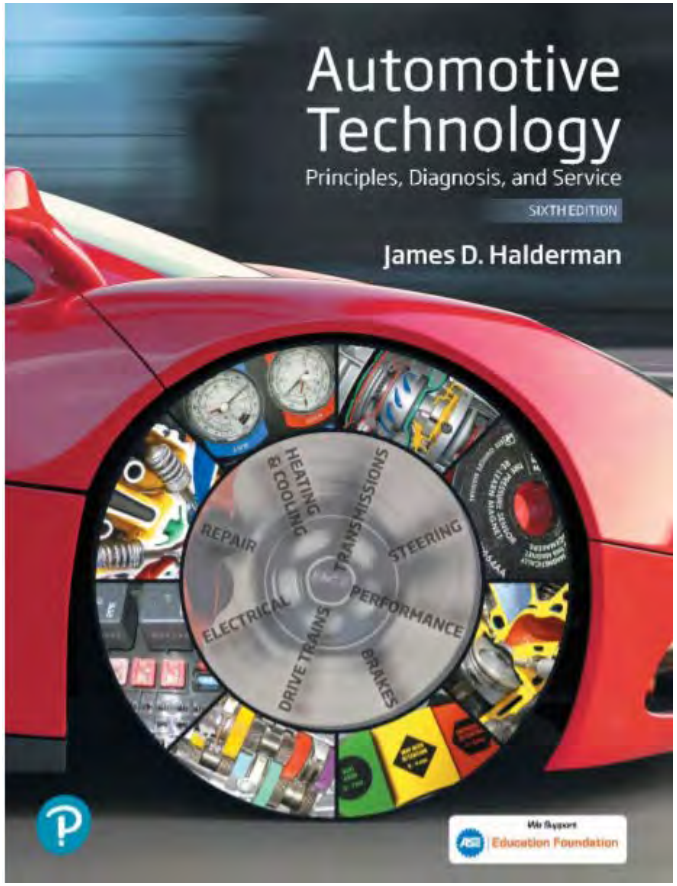
Prerequisites: Related work experience

This course is designed to provide the student with the latest state-of-the-art technology as related to automotive electronics. This course will focus on such criteria as: test equipment for solid state circuitry, electronic cruise control, level ride, travel assist and driver information centers, keyless entry system, and sound systems including service. On-bench and on-car practical exercises are featured with the classroom activities.

(2 contact hrs)

South Campus.

Advanced Driver Assistance and Safety Systems Information is now being added to Automotive Service Technician Textbooks



I am pleased to announce that the "Best Automotive Textbook Ever, Just Got Better". The new sixth edition of Automotive Technology will be available later this month. Here are the features of the new edition:

* The number of chapters have been increased from 130 to 136 making it easier to select the exact content to study or teach. The new chapters include:
* Chapter 58 - Safety, Comfort and Convenience Accessories
* Chapter 59 - Security and Immobilizer Systems.
* Chapter 61 -Autonomous Vehicles- Operation and Service Procedures.
* Chapter 64- Air Management System.
* Two new chapters were added under the hybrid vehicle section titled Hybrid High-Voltage Batteries (Chapter 92) and Electric and Plug-in Hybrid Electric Vehicles (Chapter 93)
* The chapter on power steering was expanded and then split into two chapters Hydraulic Power Steering Systems (Chapter 122) and Electric Power Steering Systems (Chapter 123)
* A new chapter titled Vibration and Noise Diagnosis and Correction (Chapter 132) was added in response to instructor requests.
* Over 200 new full-color photos and line drawings to make the subject come alive.
* Updated throughout and correlated to the latest ASE tasks.
* New Case Studies included in this edition that includes the "three Cs" (Complaint, Cause and Correction).

Vehicle Development Technician (VDT)

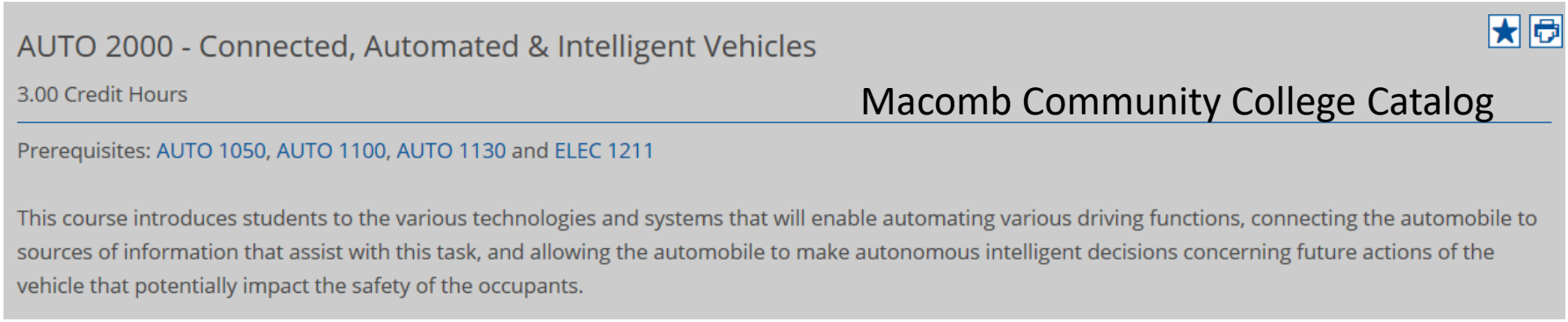
- 2-year Associate Degree in Automotive Technology
- Will work with engineers at an OEM or supplier
- Will work on test and prototype systems – no service manual
- Needs to learn additional skills in addition to mechanical skills
  - Electronic
  - Computers and software
  - Experimental testing
- Began Fall 2018 at Macomb Community College

Vehicle Development Technician Degree Combines Automotive Technology, Engineering Technology, and Information Technology Courses

Automotive Systems	Course	Credits
Introduction	AUTO 1000 Automotive Systems	3
Transmissions	(drop)	
Engines	AUTO 1200 Automotive Engines	3
Brakes	AUTO 1100 Automotive Brake Systems	3
Chassis	AUTO 1130 Automotive Steering and Suspension	3
Electrical-Electronics	AUTO 1040 Automotive Electrical I AUTO 1050 Automotive Electrical II	3 3
Other	AUTO 2000 Connected, Automated, Intelligent Vehicles (NEW COURSE)	3
Engineering Technology/Electronics		
Fundamentals	TMTH 1150 RCL Analysis ELEC 1161 Electronic Technology 1 ELEC 1171 Electronic Technology 2	4 3 3
Applications	ELEC 1211 Digital Electronics Basics ELEC 2150 LabVIEW Basics 1	3 3
Software	ITCS 1140 Intro. to Program Design & Development	4
Networking	ITNT 1500 Principles of Networking	4
Testing	ELEC 2310 Vehicle Experimental Testing (NEW COURSE)	4
Product Design	PRDE 1250 Basic Blueprint Reading	2
Science Elective	PHYS 1180 Physics (recommended)	4

A Vehicle Development Technician will take a completely New Course that was developed by CAAT using Seed Funding: AUTO 2000

- Created by Prof. Gary Mullett of Springfield Technical Community College
- The course materials are available for free to anyone at the CAAT web site
  http://autocaat.org/webforms/ResourceDetail.aspx?id=4551



AUTO 2000 - Connected, Automated & Intelligent Vehicles

3.00 Credit Hours

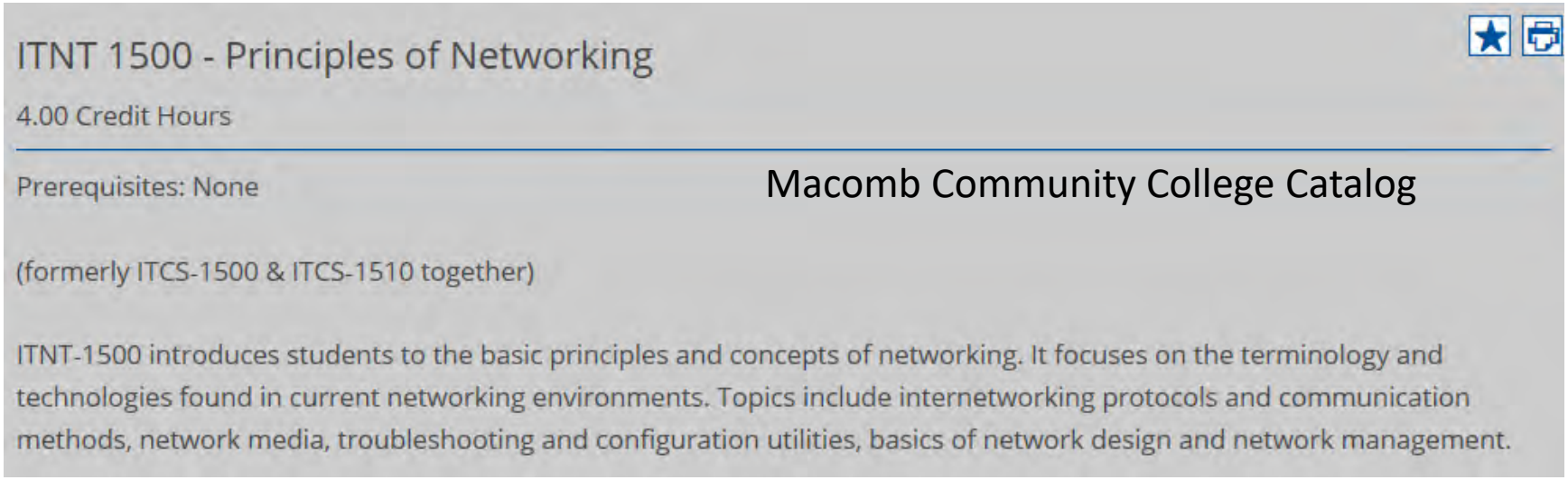
Macomb Community College Catalog

Prerequisites: AUTO 1050, AUTO 1100, AUTO 1130 and ELEC 1211

This course introduces students to the various technologies and systems that will enable automating various driving functions, connecting the automobile to sources of information that assist with this task, and allowing the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants.

A Vehicle Development Technician will take an Existing Course from Information Technology

- ITNT 1500, “Principals of Networking”
- Networking terms, architecture, standards, addressing, protocols, security, network design, management, and troubleshooting



ITNT 1500 - Principles of Networking

4.00 Credit Hours

Prerequisites: None

Macomb Community College Catalog

(formerly ITCS-1500 & ITCS-1510 together)

ITNT-1500 introduces students to the basic principles and concepts of networking. It focuses on the terminology and technologies found in current networking environments. Topics include internetworking protocols and communication methods, network media, troubleshooting and configuration utilities, basics of network design and network management.

Auto 2000, Connected, Automated, and Intelligent Vehicles: Course Outcomes

- Outcome 1: Student will be able to explain the benefits of computer controlled electro-mechanical systems on vehicles
- Outcome 2: Student will be able to explain the six different levels of automation

- Outcome 3: Student will compare the types of sensor technology needed to implement remote sensing of objects

- Outcome 4: Student will be able to explain the concept of a connected vehicle

  Objectives:

  1. Apply the basic concepts of wireless communications and wireless data networks
  1. Interpret the role of various organizations in the development and evolution of vehicle to vehicle and vehicle to infrastructure standards
  2. Give real-world examples of data networking and its roll in advanced driver assistance systems (ADAS) and future autonomous vehicles
  3. Identify protocols, and IP addressing, and on-board vehicle networks
- Outcome 5: Student will analyze the concept and advantages of sensor data fusion

Course syllabus:
http://ecatalog.macomb.edu/content.php?catoid=33&navoid=3127

Auto 2000 Course Outline by Week

1. Introduction to Automated, Connected, and Intelligent Vehicles

   Introduction to the Concept of Automotive Electronics; Automotive Electronics Overview, History & Evolution; Infotainment, Body, Chassis, and Powertrain Electronics; Advanced Driver Assistance Electronic Systems

2. Connected and Autonomous Vehicle Technology

   Basic Control System Theory applied to Automobiles; Overview of the Operation of ECUs; Basic Cyber-Physical Systems, Theory and Autonomous Vehicles; Role of Surroundings Sensing Systems and Autonomy; Role of Wireless Data Networks and Autonomy

3. Sensor Technology for Advanced Driver Assistance Systems

   Basics of Radar Technology and Systems; Ultrasonic Sonar Systems; Lidar Sensor Technology and Systems; Camera Technology; Night Vision Technology; Other Sensors; Use of Sensor Data Fusion; Integration of Sensor Data to On-Board Control Systems

4. Overview of Wireless Technology

   Wireless System Block Diagram and Overview of Components; Transmission Systems - Modulation/Encoding; Receiver System Concepts - Demodulation/Decoding; Signal Propagation Physics; Basic Transmission Line and Antenna Theory

5. Wireless System Standards and Standards Organizations

   Role of Standards; Standards Organizations; Present Standards for Autonomous Applications

6. Wireless Networking and Applications to Vehicle Autonomy

   Basics of Computer Networking - the Internet of Things; Wireless Networking Fundamentals; Integration of Wireless Networking and On-Board Vehicle Networks; Review of On-Board Networks - Use & Function

7. Connected Car Technology

   Connectivity Fundamentals; Navigation and Other Applications; Vehicle-to-Vehicle Technology and Applications; Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications; Wireless Security Overview

Auto 2000 Course Outline by Week

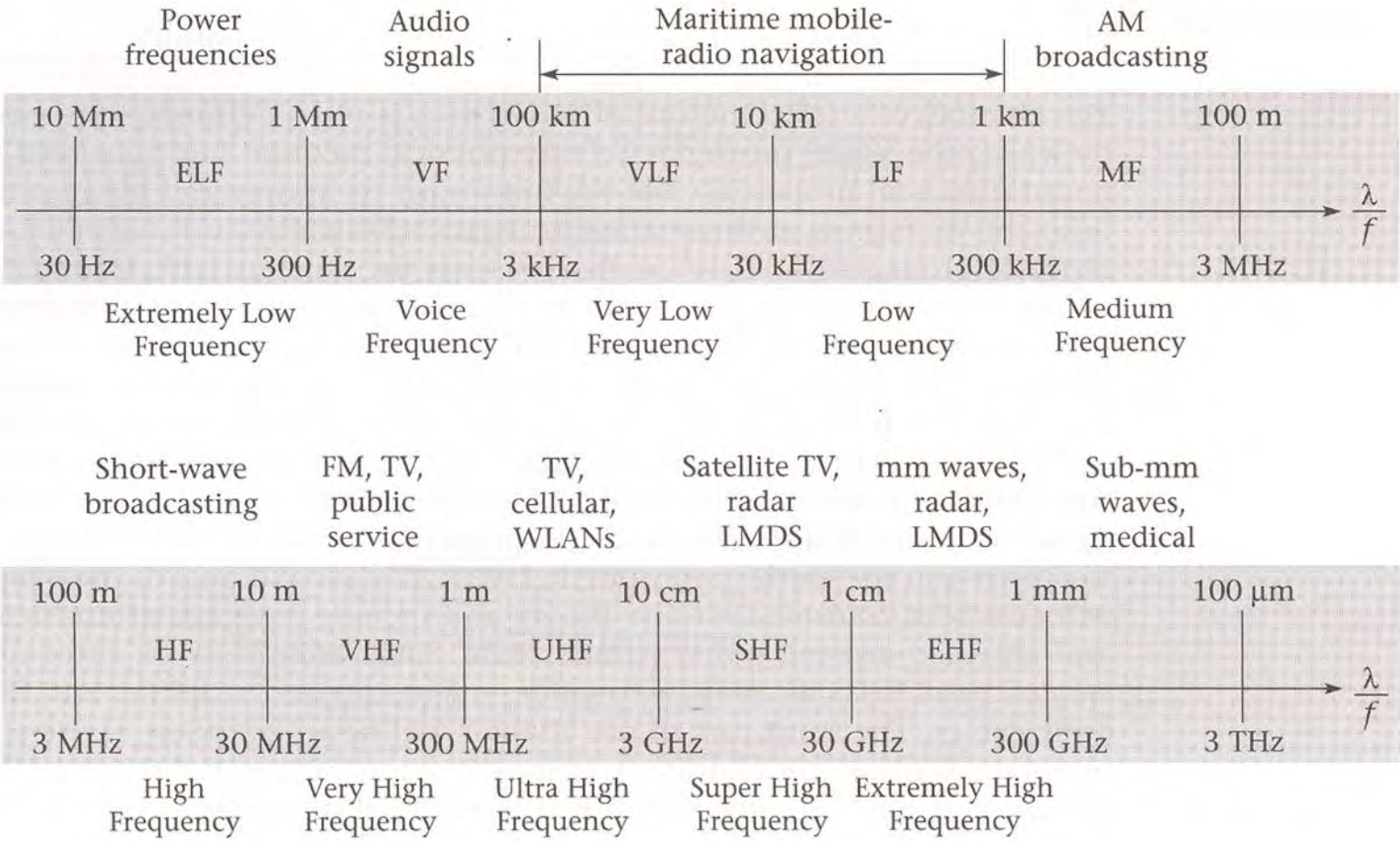
8. Advanced Driver Assistance System Technology
   - Basics of Theory of Operation; Applications - Legacy; Applications - New, Applications - Future; Integration of ADAS Technology into Vehicle Electronics; System Examples; Role of Sensor Data Fusion
9. Connected Car Display Technology
   - Center Console Technology; Gauge Cluster Technology; Heads-Up Display Technology; Warning Technology - Driver Notification
10. Impaired Driver Technology
   - Driver Impairment Sensor Technology; Sensor Technology for Driver Impairment Detection; Transfer of Control Technology
11. Vehicle Prognostics Technology
   - Monitoring of Vehicle Components; Basic Maintenance; End-of-Life Predictions; Advanced Driver Assistance System Sensor Alignment and Calibration
12. Autonomous Vehicles
   - Driverless Car Technology; Moral, Legal, Roadblock Issues; Technical Issues; Security Issues
13. Present Advanced Driver Assistance System Technology Examples
   - Toyota, Nissan, Honda, Hyundai; Volkswagen, BMW, Daimler; Fiat Chrysler Automobiles; Ford, General Motors
14. Troubleshooting and Maintenance of Advanced Driver Assistance Systems
   - Failure Modes - Self Calibration; Sensor Testing and Calibration; Redundant Systems; Standard Manufacturing Principles
15. Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation
   - Uber/Lyft - Disruptive Technology; Trucking; Farming; Mining; Shipping & Rail; Military
16. Course review and final exam

Auto 2000 Course Outline by Week

1. Introduction to Automated, Connected, and Intelligent Vehicles	67 slides
2. Connected and Autonomous Vehicle Technology	64 slides
3. Sensor Technology for Advanced Driver Assistance Systems	77 slides
4. Overview of Wireless Technology	109 slides
5. Wireless System Standards and Standards Organizations	102 slides
6. Wireless Networking and Applications to Vehicle Autonomy	102 sides
7. Connected Car Technology	55 slides
8. Advanced Driver Assistance System Technology	83 slides
9. Connected Car Display Technology	42 slides
10. Impaired Driver Technology	33 slides
11. Vehicle Prognostics Technology	21 slides
12. Autonomous Vehicles	31 slides
13. Present Advanced Driver Assistance System Technology Examples	4 slides
14. Troubleshooting and Maintenance of Advanced Driver Assistance Systems	40 slides
15. Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation	38 slides
16. Course review and final exam	0 slides

The EM Spectrum

This figure shows the EM spectrum from 30 Hz to 3 THz. The range from 300 GHz to 3 THz is receiving a great deal of attention recently for possible telecommunication and medical imaging applications.



Emerging IEEE wireless technologies

- The IEEE wireless technologies (i.e. 802.11, 802.15, 802.16, etc.) keep evolving
- IEEE 802.11 (Wi-Fi) is the technology standard of local area networks (LANs) and has been extended by 802.11p to include vehicle-to-vehicle (V2V) communications for automobile safety applications
- Data speeds >1Gbps (Wi-Gig) are being standardized for IEEE 802.11ac and 802.11ad

V2X System Troubleshooting

- The NHTSA will most likely publish minimal V2V and V2X operational standards that will include range of operation, power output levels, receiver sensitivity, etc., as well as more details of the basic safety message (BSM) to be transmitted and system security

- However, dealing with radio transmitters and receivers has until now been the domain of the radio engineer or technician – this field often uses test and measurement equipment that can be extremely expensive – spectrum analyzers, power meters, etc.

Wireless Networking Tools

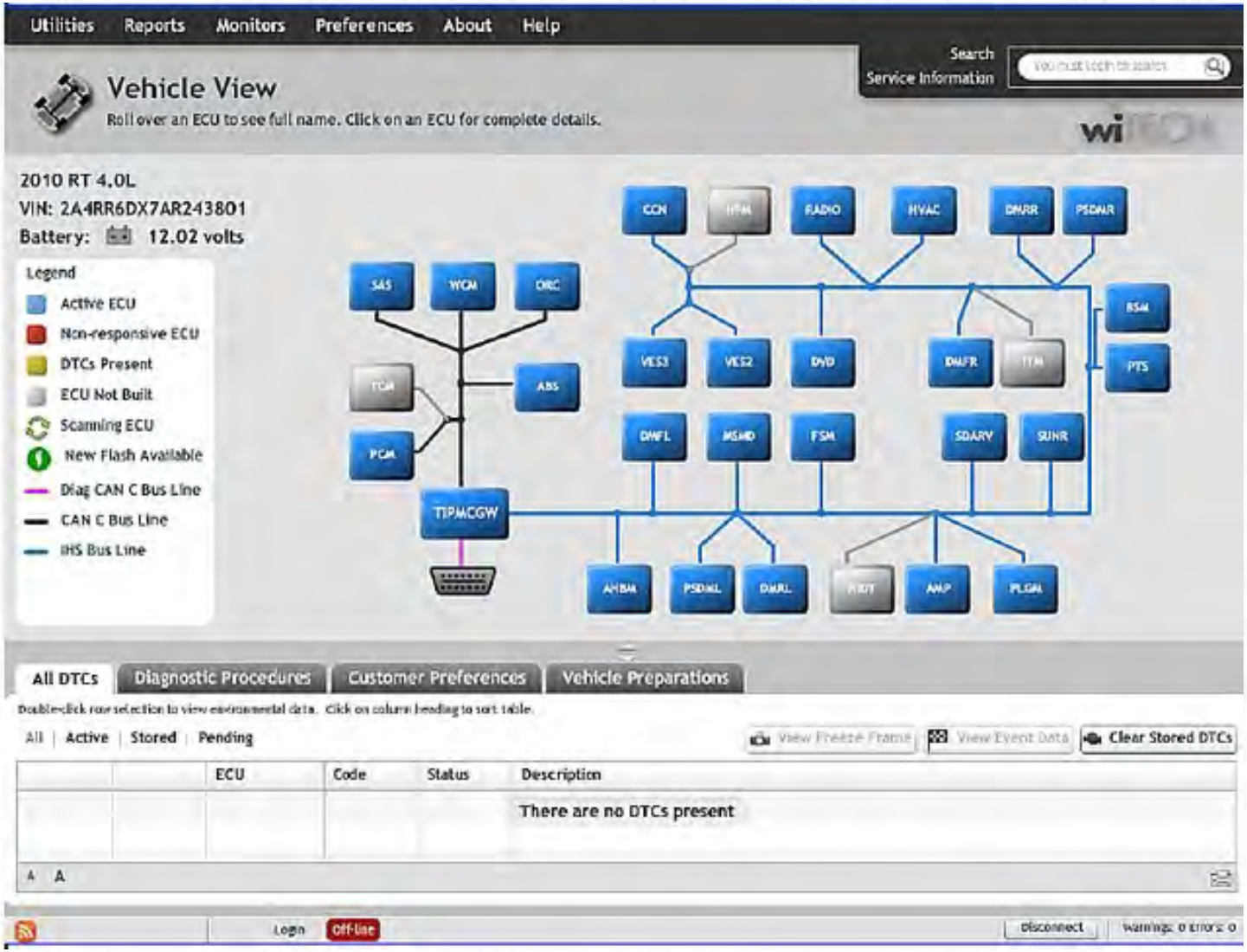
- Software tools like WireShark (an RF sniffer) come to mind when one considers checking the operation of wireless data networks

- Again, how much troubleshooting and testing of these future on-board wireless networking systems is possible by an automotive technician is anyone's guess at this time – most likely, considering the Tx/Rx hardware as FRUs might work best

- Other needed RF/wireless hardware like antennas and transmission lines also complicates the troubleshooting situation

Delphi Diagnostic Tools

Typical Diagnostic Tool Display



Examples of ADAS Troubleshooting

- For ADAS troubleshooting the diagnostic test equipment needed has become more complex and sophisticated

- Much of the diagnostics are done with a PC or a specialized tester under program control with Windows based test programs

- At this time, the students of this course should be exposed to several of the Wabco ADAS maintenance manuals - the Meritor OnGuard™ Collision Mitigation System and the Meritor OnLane™ LDW system are useful

Examples of ADAS Troubleshooting (Cont.)

- These maintenance manuals are found on the Meritor Wabco web site at:

  http://www.meritorwabco.com/#

- Under **Literature**, on the above web site, one can find the links to these maintenance manuals which are extremely detailed and thorough – they go through installation, theory of operation, troubleshooting and testing, diagnostic codes, alignment, and how to use Wabco's TOOLBOX™ software to diagnose, troubleshoot, and test these ADAS systems

ADAS Troubleshooting Software - TOOLBOX™

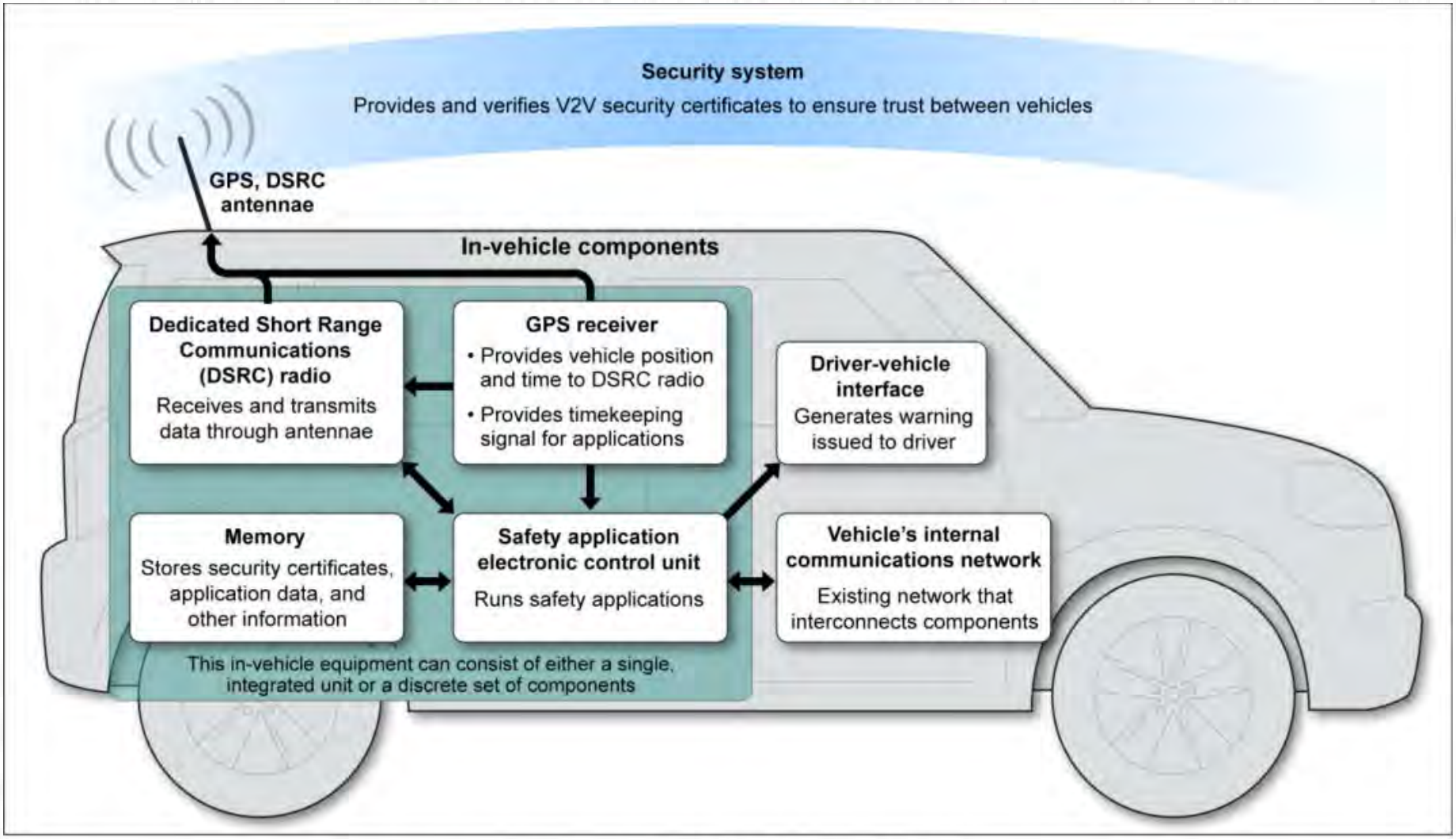
- The TOOLBOX™ software (available on the web site for purchase) interface looks like this:

ADAS Troubleshooting Software - TOOLBOX™

- The software allows one to connect to the ODBII port through various adaptors and except for the fact that these ADAS systems are employed on trucks and trailers the processes needed to connect to the particular ADAS system are similar to what one would find for a passenger car

- This is the future workspace of the vehicle/ automotive technician when one deals with advanced ADAS systems and eventually autonomous vehicles! IT/PC skills become extremely necessary and important!

V2V Component Details



Sources: Crash Avoidance Metrics Partnership and GAO.

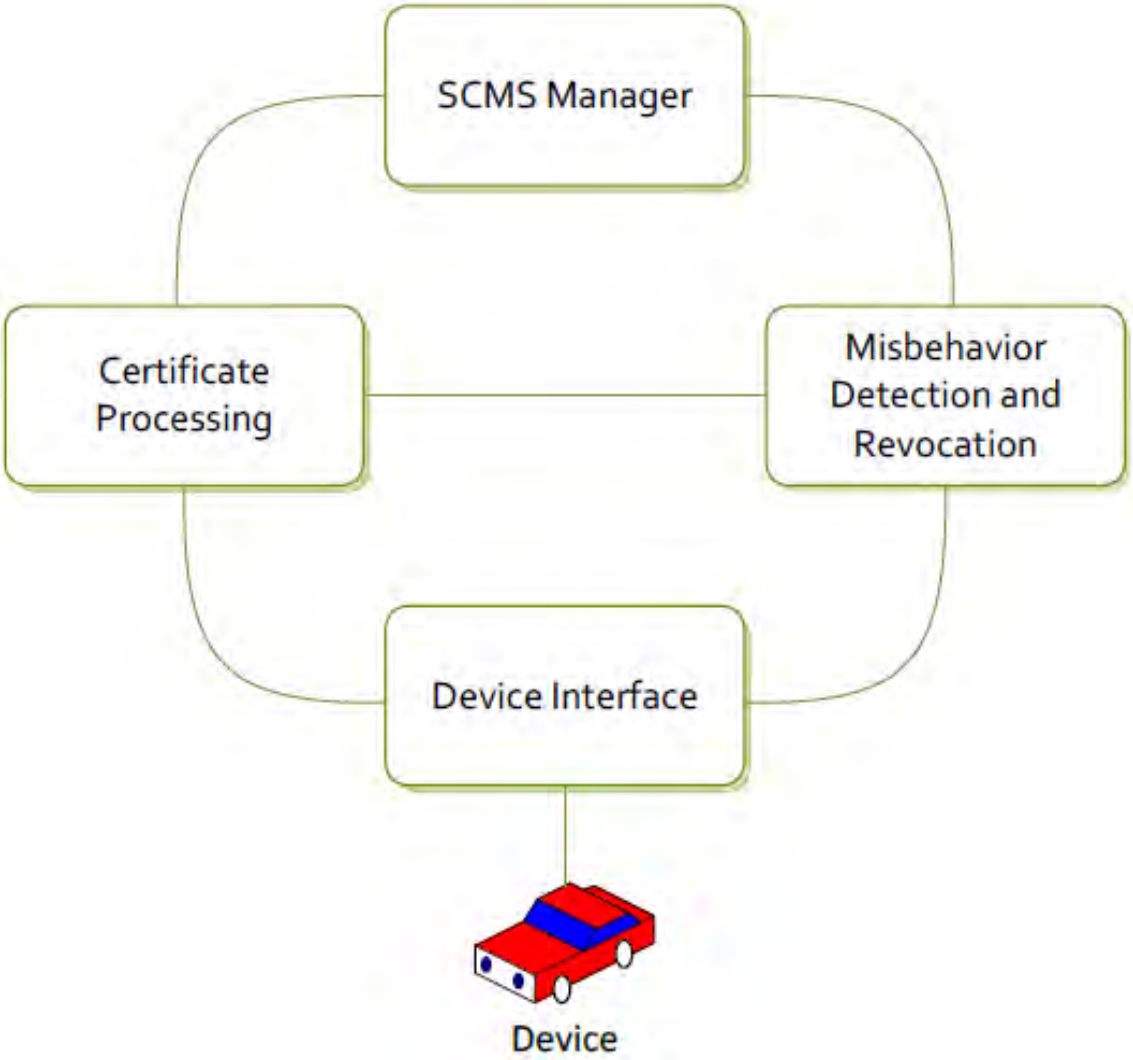
V2V Wireless Security Overview

- Wireless security has been an important consideration for V2V communications

- Today, most are aware of the dangers of being hacked – with that in mind, the NHTSA has developed cybersecurity guidance – available on the NHTSA website

- The security built into V2V systems depends on several “entities” to function correctly – the SCMS (security credentials management system) oversees security operations

V2V Security System



This details of how this security system works is out of the scope of what this work is attempting to accomplish here – suffice to say - the security design makes use of short-term digital certificates used by a vehicle's on-board equipment to authenticate and validate sent and received basic safety messages that form the foundation for V2V safety technologies

Working on ADAS Equipped Vehicles

- ADAS sensor testing
  - Radar, camera, and LiDAR generate complex data sets
- Troubleshooting V2X
  - New skills for automotive technician
  - NHTSA operational standards
  - Spectrum analyzers, power meters are expensive
- System re-calibration and alignment
  - JN Phillips calibration for windshield repairers
- Wireless networking tools
  - WireShark (an RF sniffer)

How Does this Affect Education?
New Skills Required in the Field of Connected Vehicles

- Understanding of Wireless Communications (DSRC, Wi-Fi Cellular/4G LTE, Bluetooth, antennas)
- Electronics skills (sensor signals and noise, digital signals, CAN and communication protocols, Ethernet, displays, soldering, shielding, troubleshooting, oscilloscopes)
- Software Skills (programming, algorithms, embedded systems, networks, security systems, user interfaces, data acquisition and analysis)
- Cybersecurity

Summary

- Traditional Auto Service Technician Degree programs are adding ADAS safety and security information that addresses vehicle connectivity
- Vehicle Development Technician Degree has CAV and IT content that addresses connectivity
  - AUTO 2000, Connected, Automated, and Intelligent Vehicles
  - ITNT 1500, Principals of Networking
  - http://ecatalog.macomb.edu/preview_entity.php?catoid=27&ent_oid=2838

Could this dog drive a Cadillac CT6 on the highway?

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Contact Information

Nelson A. Kelly
Assistant Director, Energy and Automotive Technology
Center for Advanced Automotive Technology (CAAT)
Macomb Community College
14500 East 12 Mile Road
Warren, MI 48088-3896

Phone: 586-447-8619

Email: kellyn@macomb.edu

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