Michigan Connected and Automated Vehicle Working Group

April 26, 2018

Meeting Packet

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

Michigan Connected and Automated Vehicle Working Group

April 26, 2018

Danlaw Inc.
41131 Vincenti Court, Novi, MI 48375

Meeting Agenda

12:30 PM	**Registration and Networking**
01:00 PM	**Introduction and Update** Richard Wallace, Vice President, TSA Group, Center for Automotive Research
	Driving Innovation: Danlaw's Approach to Connected Vehicles Mike Carroll, Vice President Connected Car, Danlaw Inc. Andrew Donaldson, Program Manager, Danlaw Inc.
	Open Standards for Enabling Successful Autonomous Vehicle Simulation Tim Palmer, Ground Vehicle Application Engineering Manager, MSC Software Daniel Heckman, Account Manager, MSC Software
	Bosch Smart City Introduction Frank Sgambati, Director, Business Development – Smart City, Robert Bosch LLC
02:40 PM	**Networking Break**
03:00 PM	**Hot Topics Discussion** Scott Shogan, Vice President, Connected/Automated Vehicle Market Leader, WSP
	PlanetM – Activating Technology through Testing and Deployment Kathryn Snorrason, Business Development Manager, PlanetM, Michigan Economic Development Corporation
	Connecting Communities Through Self-Driving Microtransit Steve Vozar, CTO and Co-Founder, May Mobility
04:00 PM	**Meeting Adjourned / V2X Demonstrations**

Michigan Connected and Automated Vehicle Working Group

The 2018 spring meeting of the Michigan Connected and Automated Vehicle Working Group was held on April 26, 2018 and hosted by Danlaw Inc. (41131 Vincenti Court, Novi, MI 48375).

Meeting Notes

Richard Wallace, Vice President, Transportation Systems Analysis Group at the Center for Automotive Research (CAR), opened the meeting and detailed the agenda, Working Group mission, and noteworthy connected and automated vehicle (CAV) events. Richard highlighted the ITS America Annual Meeting and TU Automotive Detroit in June, as well as CAR's upcoming Management Briefing Seminars in August.

After Richard's introduction, Mike Carroll, Vice President Connected Car at Danlaw Inc., welcomed the group and gave an overview of Danlaw's approach to connected vehicles. Among the company's noteworthy activities in this space, Mike mentioned that Danlaw and Azuga are developing a technology solution to support Road Usage Charging (RUC) in several western states. Then, Andrew Donaldson, Program Manager at Danlaw Inc., focused on the company's vehicle-to-everything (V2X) technologies. Danlaw started developing solutions using Dedicated Short-Range Communication (DSRC) in 2015, specifically related to the certification of DSRC devices through the Omniair Consortium. Andrew also presented Danlaw's V2X development tools (MxSuite, MxDSRC, and MxDrive), and products (on-board unit, through-glass antenna, and road-site unit).

Following Mike and Andrew's presentation, Daniel Heckman, Account Manager at MSC Software, Tim Palmer, Ground Vehicle Application Engineering Manager at MSC Software, addressed the need for open standards for enabling automated vehicle simulation. Standardized test scenarios and methods are necessary to eliminate duplicative efforts and ensure the safety of automated vehicles. MSC Software is one of the organizations that contributed to the development of standardized data formats (OpenCRG, OpenDrive, OpenScenario) for testing scenarios. MSC Software also was a partner in Pegasus and ENABLE-S3, two research projects aimed at producing standardized procedures.

After Daniel and Tim's presentation, Frank Sgambati, Director Business Development Smart City at Robert Bosch LLC, gave an introduction on his company's current and future activities in the smart city space. Bosch is developing products and services for smart communities (infrastructure and building projects for greenfield of brownfield real estate developments) and smart cities (mobility projects at the level of an entire city). For example, Bosch launched the e-scooter sharing-service Coup (Berlin and Paris) and is developing a mobility-as-a-service smartphone application (Stuttgart, Germany).

After a short break, Scott Shogan, Vice President and CAV Market Leader at WSP, facilitated the discussion on the latest CAV topics in the news. First, the Working Group members exchanged views on the deployment of two main connected vehicle technologies, cellular 5G and DSRC. Some of the meeting attendees expect that Toyota's commitment to equip new vehicles with DSRC starting with 2021 will reassure state and local governments that deploying this technology on their roads will be useful; however, it is too soon to say whether Toyota's move will encourage other automakers to take the same route. The participants also talked about the implications of the fatal crash caused by an Uber automated test vehicle for the overall industry. Several attendees made comparisons with past incidents related to airbags or seat belts that had a lasting impact on the automotive industry. While a single fatal crash involving an automated test vehicle is not a representative sample, companies and government agencies likely will increase their vigilance when it comes to developing safe automated vehicles.

Kathryn Snorrason, Business Development Manager PlanetM at the Michigan Economic Development Corporation (MEDC), provided the Working Group with an update on PlanetM's strategy and activities. PlanetM's three core business development goals are technology activation, company connections, and asset coordination. Kathryn gave a preview of the Startup Grant Program for testing and pilots that will be launched officially at the ITS America Annual Meeting in June 2018 in Detroit. Kathryn also talked about how PlanetM supports company connections through a variety of events and its Landing Zone, a mobility-focused co-working space.

Steve Vozar, CTO and Co-Founder of May Mobility, closed the meeting with a presentation of his company's solution for connecting communities through automated microtransit. This Ann Arbor-based startup created in 2017 uses low-speed (maximum 30 mph), six-person vehicles and sensors from suppliers, but it develops its own drive-by-wire, automated driving software, sensor integration, and user experience. The best use cases for May Mobility's automated shuttles are fixed routes on campuses, downtown areas, and neighborhoods. The company conducted a short pilot in Detroit in October 2017 and has several other pilot deployments in process.

At the end of the meeting, Danlaw Inc. demonstrated some of its V2X communication technologies to the Working Group members.

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

Attendance List

First name	Last name	Organization	Email
John	Abraham	Macomb County Department of Roads	jabraham@rcmcweb.org
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Cynthia	Doherty	The Fulkerson Group	cyndy@fulkersongroup.com
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Michigan Connected and Automated Vehicle Working Group

Handouts

ITS MICHIGAN BREAKFAST

Join the Intelligent Transportation Society of Michigan (ITSM) on Thursday, June 7th for a special breakfast presentation from **MDOT Director Kirk Steudle.**

WHEN

Thursday, June 7, 2018

7:30 AM	Registration/Breakfast/ Networking
8:00 AM	Keynote Speaker MDOT Director, Kirk Steudle
8:30 AM	ITS Michigan Overview & What's New

WHERE

ITS American 2018 Annual Meeting

Cobo Convention Center

1 Washington Blvd

Detroit, MI 48226

Free for members / $20 for non-members

(Note: all attendees (members and non-members) must register by May 11)

REGISTER NOW:

www.itsmichigan.org

ITS-Michigan
Intelligent Transportation Society

SQUARE ONE™
EDUCATION NETWORK
the future starts with us

You are cordially invited to attend the

2018 Innovative Vehicle Design Mobility Challenge Competition

Date: Saturday, May 19, 2018
Time: Performances Open 10am to 4pm
Location: Mcity Test Facility,
University of Michigan Mobility Transformation Center
2901 Baxter Rd., Ann Arbor MI

Linking excellent teaching and learning practices with increasing corporate demands for skilled, creative and energetic employees, the IVD programs showcase the creative engineering strengths of today's students at a regional competition that focuses on vehicle performance and endurance.

Teams compete in one of the following challenges: student-built, go-kart sized electric vehicles, autonomous vehicles built on Power Wheels Jeep platforms, and 1/10th scale radio-controlled re-engineering challenge.

These three vehicular engineering projects are exciting, complex and relevant learning opportunities for youth. Join us to meet the 60 competing teams from around the state as well as our new connected vehicle exhibition teams.

Admission is free.

Square One is a Michigan-based 501c3 educational organization. Square One's mission is to Empower teachers with a complete set of resources for students to engage, using hands-on learning tools and modern learning fundamentals, with the intent of developing skills needed for the next generation technical workforce.

Our vision is to prepare students with the essential skillset for higher learning institutions and the rapidly evolving needs of STEM related jobs.

INNOVATIVE VEHICLE DESIGN™

Proud Partners in

SQUARE ONE NATION

INNOVATIVE VEHICLE DESIGN™

The Square One Education Network Innovative Vehicle Design Mobility Challenge Competition is **Made Possible With the Support of…**

P3 Group
Washtenaw Community College
Nissan
Michigan Dept. of Talent and Economic Development (TED)
Michigan Economic Development Corporation – Planet M
Tata Technologies
Eisbrenner Public Relations
Good Sense Media ~ Harris Battery ~ **Larry's RC**

Special thanks to our hosts at M-City

Full Scale IVD Custom Division:	Safety Check	Figure 8	City Scape
1. Frederick Douglass Academy	8:15	10:00	1:00
2. Macomb Academy Arts/Sciences	8:15	10:00	1:00
3. Wm. D Ford Career Center	8:15	10:00	1:00
4. Williamston HS	8:30	10:30	1:00
5. University HS	8:30	10:30	1:00
6. Southfield HS	8:30	10:30	1:00
7. Oxford High School Team 1	8:45	11:00	1:00
8. Branch Area Career Center	8:45	11:00	1:00
9. Manoogian School	8:45	11:00	2:15
10. Flex Tech HS	9:30	11:30	2:15
11. Lapeer Technical Center	9:30	11:30	2:15
12. Kenowa Hills, Grand Rapids	9:30	11:30	2:15
13. Pioneer HS Ann Arbor	9:15	12:00	2:15
14. Huron County	9:15	12:00	2:15
15. Wilson Talent Center	9:15	12:00	2:15
16. Oxford High School Team 2	9:30	12:30	2:15

Full Scale IVD Noted by Green Flag

Teams of high school students design, engineer, and build a fully functional one-person vehicle. Each car must have a unique component that sets it apart from its competitors. Students' projects have included innovations from across the spectrum of automobile engineering disciplines: safety features, body styling, driver comforts and more. Teams were encouraged to look at "Light-weighting" and sensor technology for this year's challenge. Full Scale IVD cars compete on two courses: Figure 8 for 30 minutes and the Ford Cityscape for one hour. Project Specialist Doug Ward with support from Specialist Jim Schirmer. Sponsors include Planet M and TATA Technologies!

You can find photos and video from today on Square One Education Network's Facebook and Twitter @SquareOneNet or website www.squareonenetwork.org

Instagram, Snapchat, Tweet #IVD2018

Mini Innovative Vehicle Design Racing – Noted by Yellow Flag

Students start with a 1/10th scale off the shelf 2-wheel drive RC vehicle, conduct a series of performance tests, collect and analyze their data and then convert the vehicle to 4-wheel drive, with an emphasis on the physics at work, programming, and tuning the vehicle for optimal performance along with skilled driving. Many teams have added a sensor innovation this year.

Mini IVD	School Name	Agility	Pit Stop Challenge **	Top Speed	Michigan Mini Oval
1A	Roseville	10:00	11:00	12:00	2:00*
2A	Chippewa Valley	10:00	11:00	12:00	2:00*
3A	Clinton HS 1	10:00	11:00	12:00	2:00*
4A	Huron Tech 1	10:00	11:00	12:00	2:00*
5A	Oxford	10:00	11:00	12:00	2:00*
6A	Waterford Kettering	10:00	11:00	12:00	2:00*
7A	Saline	10:00	11:00	12:00	2:00*
1B	Flex Tech	10:30	11:30	12:30	2:00*
2B	Grand Traverse Academy	10:30	11:30	12:30	2:00*
3B	Portage Central	10:30	11:30	12:30	2:00*
4B	Clinton HS 2	10:30	11:30	12:30	2:00*
5B	Huron Tech 2	10:30	11:30	12:30	2:00*
6B	St. Louis HS	10:30	11:30	12:30	2:00*
1C	Frederick Douglass Academy	11:00	12:00	1:00	2:00*
2C	Kenowa Hills	11:00	12:00	1:00	2:00*
3C	Lakeview	11:00	12:00	1:00	2:00*
4C	Lapeer Ed Tech	11:00	12:00	1:00	2:00*
5C	Oak Park	11:00	12:00	1:00	2:00*
6C	Waterford Mott	11:00	12:00	1:00	2:00*
7D	Sanilac	11:00	12:00	1:00	2:00*
1D	ACATEC	11:30	12:30	1:30	2:00*
2D	Reese HS	11:30	12:30	1:30	2:00*
3D	Utica CSI	11:30	12:30	1:30	2:00*
4D	Vassar	11:30	12:30	1:30	2:00*
5D	Hazel Park	11:30	12:30	1:30	2:00*
6D	WD Ford Career Center	11:30	12:30	1:30	2:00*

Project specialist is Joe Hart, Mini IVD Racing is sponsored by Nissan

Autonomous IVD	Performance Round 1	Performance Round 2
1. Divine Child, Livonia	11:30	2:30
2. Huron Area Tech Center, Bad Axe	11:30	2:30
3. Grand Traverse Academy, Traverse City	11:30	2:30
4. Glenbrook South, IL	11:30	2:30
5. Roseville HS, Roseville	11:00	2:00
6. Kalamazoo Central, Kalamazoo	11:00	2:00
7. Oak Park HS, Oak Park	11:00	2:00
8. Waterford Mott HS	11:00	2:00
9. Clinton High School, Clinton	10:30	1:30
10. Hazel Park HS	10:30	1:30
11. Wilson Talent Center	10:30	1:30
12. Portage Central HS, Portage	10:30	1:30
13. Northwest HS, Jackson	10:00	1:00
14. Saline HS, Saline	10:00	1:00
15. Vassar HS	10:00	1:00
16. Waterford Kettering, Waterford	10:00	1:00

Autonomous IVD – Noted by Pink Flag

Building upon a toddler "jeep" platform, students are introduced to C+ programming, GPS technologies, Arduino chips, and motion sensors as they re-tool it to perform various tasks autonomously with a connected vehicle theme. The teams' vehicle performance scores are based upon the level of autonomy, number and complexity of tasks they are able to achieve. Specialist Bill Grimm and P3 specialists Cody McNeill & Nate Bezanson

Autonomous Innovative Vehicle Design is sponsored by P3

V2X means Vehicle to Everything Noted by Red Flag

This exploration of real world, relevant technologies connects our vehicles wirelessly to each other and to the infrastructure. It is an effort to create a crashless society with traffic that moves safely and effortlessly. These teams will demonstrate their efforts thus far. Specialists JC Irvine and Bob Jones

V2X Masters of Mobility	Competitions
William D. Ford Career Technical Center, Westland	9:30-12
Oak Park High School	9:30-12
Hazel Park High School	9:30-12

V2X Masters of Mobility schools are sponsored by Washtenaw Community College, CTN, and the Michigan Department of Talent and Economic Development!

We hope you'll visit the concession stand.
Thanks for supporting our event today!

Many thanks to the students, teachers, parents, volunteers, partners and community members who make these projects a reality.

Welcome to the Square One Education Network
2018 Innovative Vehicle Design Mobility Challenge Competition

Square One prepares students with the essential skillset for higher learning institutions and the rapidly evolving needs of STEM related jobs. We strive to empower teachers with a complete set of resources for students to engage, using hands-on learning tools and modern learning fundamentals, with the intent of developing skills needed for the next generation technical workforce. Programs like IVD develop the talent needed to drive our economy forward!

Proud Partners in

Visit our great exhibitors in the Big Warming Tent!
WCC, MIAT, MTU, TED and more!

Today's Program of Events

9:00am Kick Off at the Main stage pavilion

10:00am ~ Performances (weather permitting) begin

Ongoing – Visit the warming tent to check out exhibits, student video presentations and concessions

11:45am to 1pm ~ Team lunch available in the Warming Tent

12:00pm begins the High Speed Challenge on the southeast corner

2:15pm kicks off the exciting Michigan Mini Oval

2-3pm and 3:15-4:15 ~ Full Scale City Scape course – Pedestrian traffic will be limited

4:15-4:45 ~ Teams help disassemble course, stack cones, etc.

5:00pm – 6:00pm ~ Awards & Scholarship Presentation - Speakers from P3

Square One's board of directors is generously sponsoring an Ice Cream Treat for teams today!

Michigan Connected and Automated Vehicle Working Group

Presentations

Michigan Connected and Automated Vehicle Working Group

Danlaw Inc.

April 26, 2018

Meeting Agenda

1:00 PM **Introductions and Update**
Richard Wallace, Vice President, TSA Group, Center for Automotive Research

Driving Innovation: Danlaw's Approach to Connected Vehicles
Mike Carroll, Vice President Connected Car, Danlaw Inc.
Andrew Donaldson, Program Manager, Danlaw Inc.

Open Standards for Enabling Successful Autonomous Vehicle Simulation
Tim Palmer, Ground Vehicle Application Engineering Manager, MSC Software
Daniel Heckman, Account Manager, MSC Software

Bosch Smart City Introduction
Frank Sgambati, Director, Business Development – Smart City, Robert Bosch LLC

2:40 PM **Networking Break**

3:00 PM **Hot Topics Discussion**
Scott Shogan, Vice President, Connected/Automated Vehicle Market Leader, WSP

PlanetM – Activating Technology through Testing and Deployment
Kathryn Snorrason, Business Development Manager, PlanetM, Michigan Economic Development Corporation

Connecting Communities Through Self-Driving Microtransit
Steve Vozar, CTO and Co-Founder, May Mobility

4:00 PM **Meeting Adjourned / V2X Demonstrations**

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

- **Motor City Plugfest**
  May 7-11, 2018 | Intertek, Plymouth, MI
- **Innovative Vehicle Design – Square One**
  May 19, 2018 |M-City, Ann Arbor MI
- **26th Annual Intelligent Ground Vehicle Competition (IGVC)**
  June 1-4, 2018 | Oakland University, Rochester, MI
- **2018 ITS America Annual Meeting & Expo**
  June 4-7, 2018 | Cobo Center, Detroit, MI
- **TU-Automotive Detroit 2018**
  June 6-7, 2018 | Suburban Collection Showplace, Novi, MI
- **CAR Management Briefing Seminars**
  July 30 – August 2, 2018 | Grand Traverse Resort, Traverse City, MI
- **Automotive LIDAR 2018**
  September 26-28, 2018 | DoubleTree Detroit-Dearborn, Detroit, MI

July 30 - August 2, 2018

Grand Traverse Resort | Traverse City, Michigan, USA

MORE THAN **1,000** attendees

MORE THAN **400** companies in attendance

MORE THAN **70** high level speakers

MORE THAN **52** years of thought leadership

Thank you to our hosts!

Driving Innovation

Danlaw's Approach to Connected Vehicles

What
We Do

DANLAW

AUTOMOTIVE MADE SMART

Connected Car

Telematics

V2X-V2V

Cloud-Based Apps

Engineering Solutions

Services & Projects

Consulting & Placements

Automotive & Aerospace Test Tools

Automotive Electronics

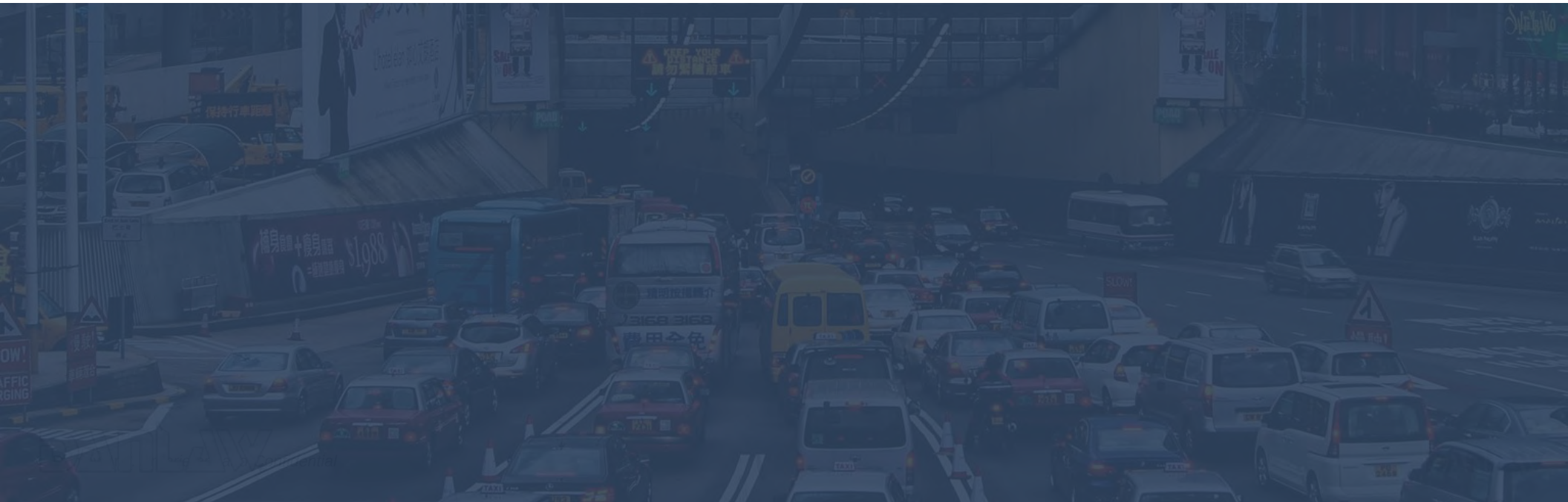
Interior Lighting Systems

Body & Chassis Electronics

Switches

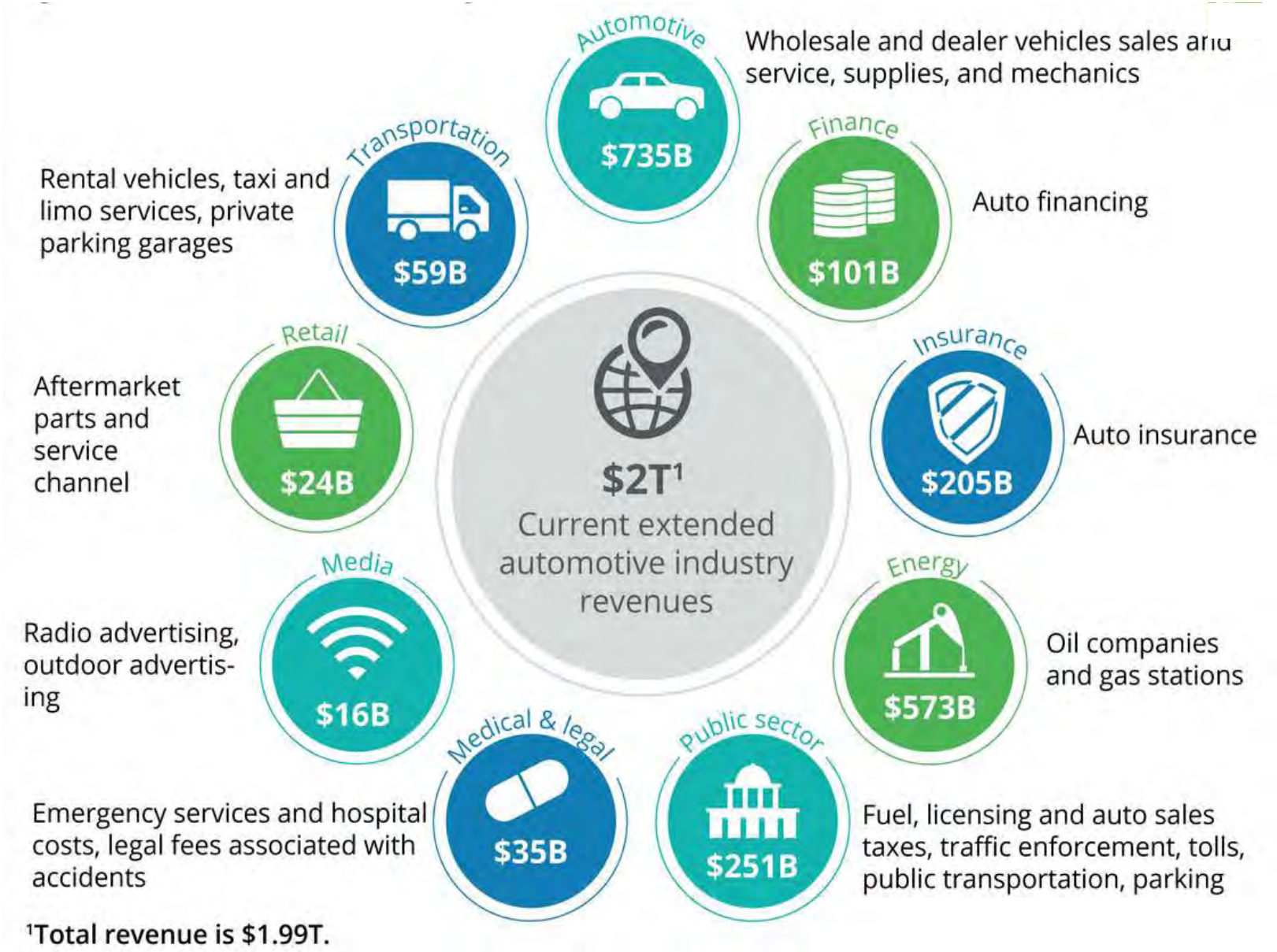
Connected Car Technology
Paving the Way for Sustainable Mobility…Safely

CAV	“Enhance safety and mobility in Michigan and beyond”
ITS	“Improving safety and travel times on the transportation system”
MDOT	“Provide the highest quality integrated transportation services for economic benefit and improved quality of life.”
PlanetM	Enhanced mobility that can save thousands of lives lost per year due to auto accidents caused by human error..”



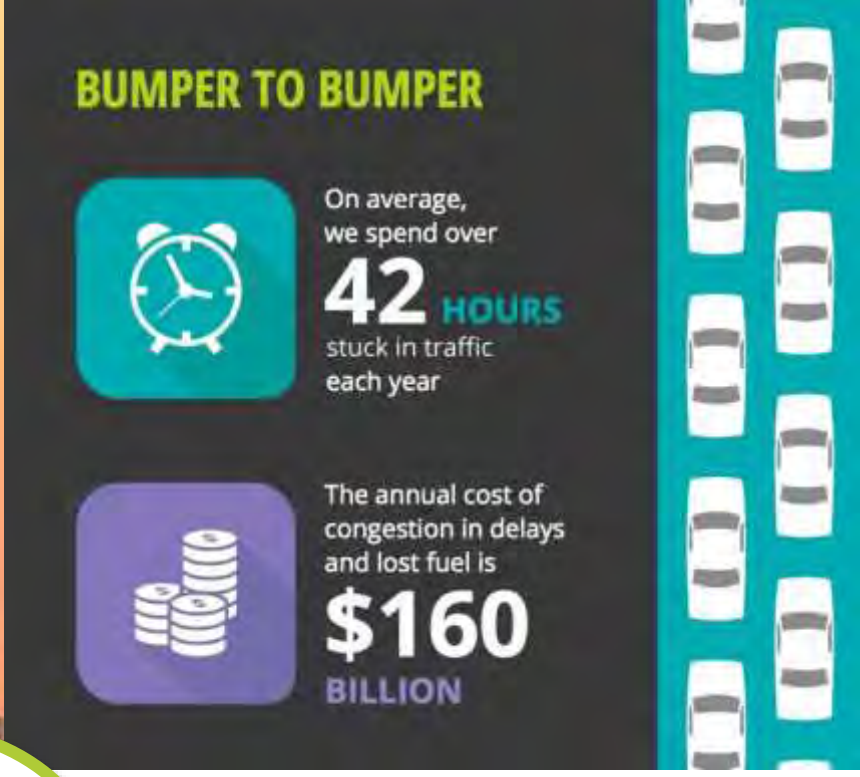
Sustainable Mobility

Why does the future of mobility matter?



Source: IBISWorld Industry Reports, HIS, DOT, US Census, EIA, Auto News

Traffic
Congestion



179 Hours Detroiters spend in traffic annually

Amount Michigan residents spend annually on lost time in traffic, wasted fuel, and car repair due to poor road conditions **$7.7 B**

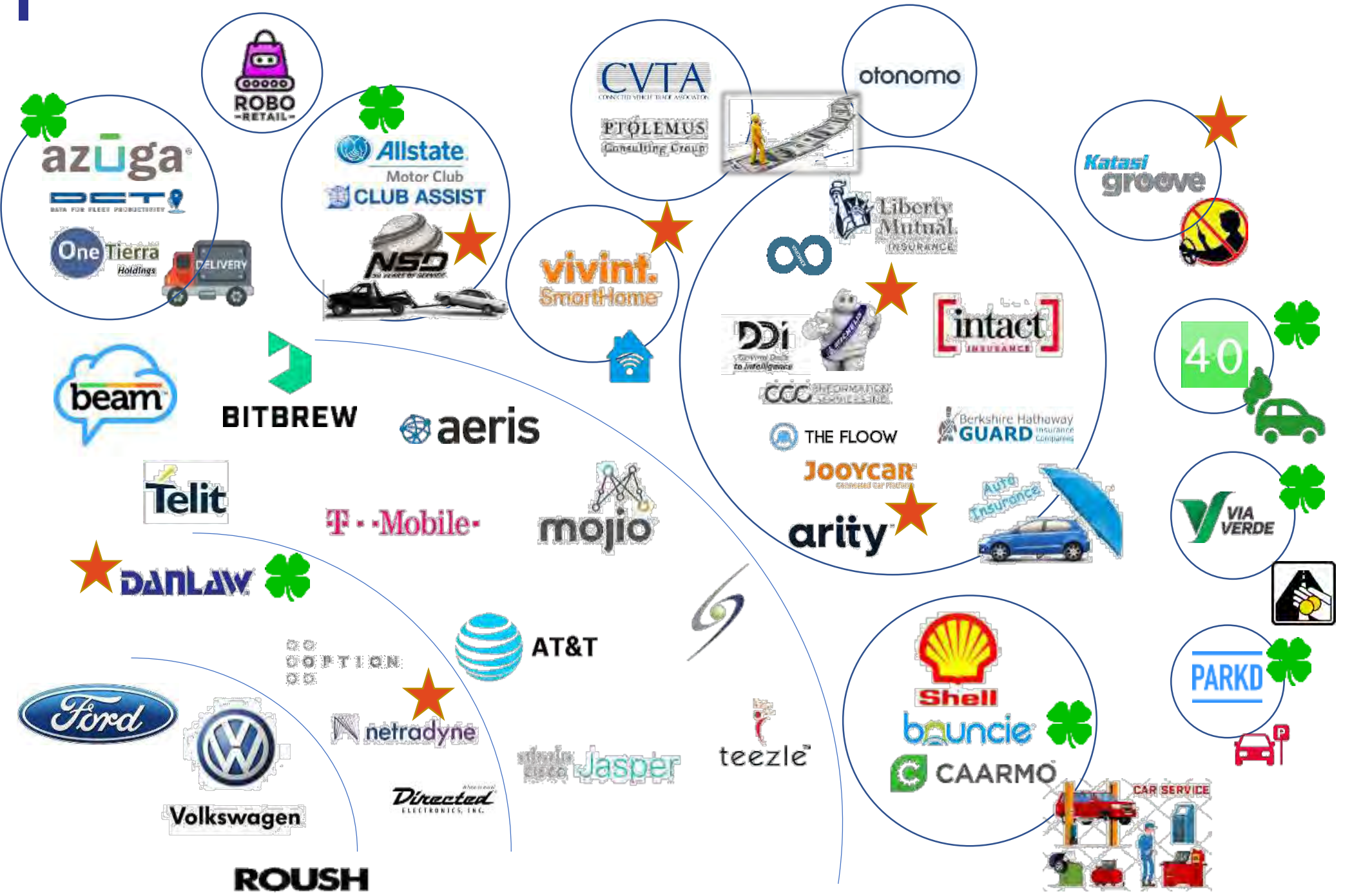
Source: Driven Apart, by Joe Cortright
National Transportation Research Group

DANLAW

- The future of Usage Based Insurance
- Accident alerts and claims reconstruction
- Distracted driving prevention
- Road usage charging and road tolling
- Engineering safer roads with telematics data
- Fleet management
- Remote emissions compliance
- Building loyalty through service applications
- Leveraging roadside assistance
- Automated parking management
- Lot management
- Monetizing data
- Consumer-ready mobile applications
- Entertainment via WiFi hotspots
- Networked automotive electronics trends
- V2V, V2I, and V2X technology

DANLAW

Think Outside the Bubble



Road Usage Charging
At A Glance

The Problem

- The federal gas tax hasn't been raised in 25 years
- Most states even with recent state increases have a sizable funding gap
- Fuel-efficient vehicles are consuming less gas (or no gas)
- National Highway Trust Fund is insolvent

The Solution

- Collect mileage from vehicles using embedded or aftermarket data collection devices and replace fuel based taxing with mileage based taxing

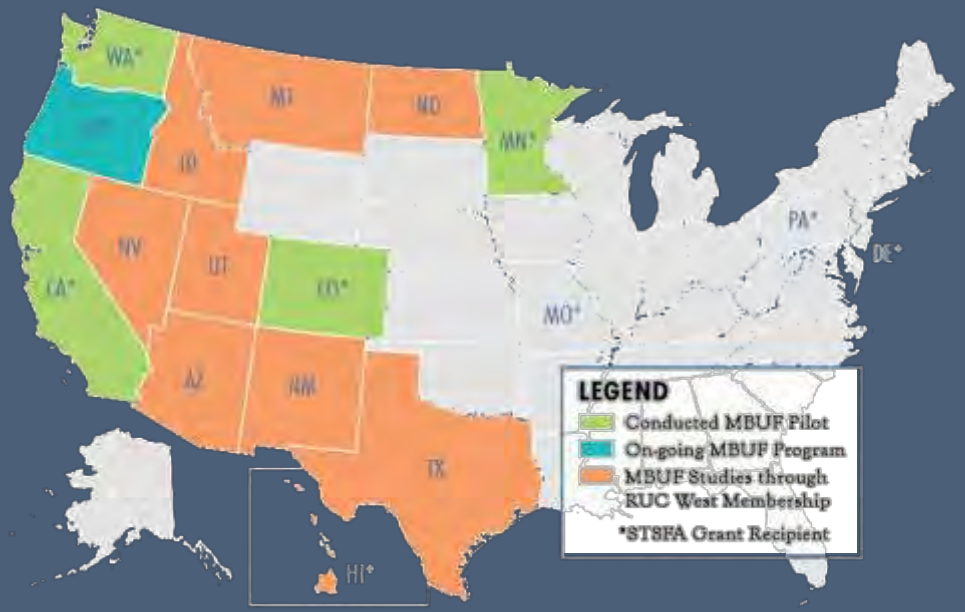
Benefits

- Mileage fees provide incentives to drivers to consider alternatives such as public transit or carpooling which can reduce congestion, vehicle emissions, and overall spending on roads and fossil fuels
- Drivers that use the roads will pay for the roads.
- Ability to capture revenue from electric and hybrid vehicles

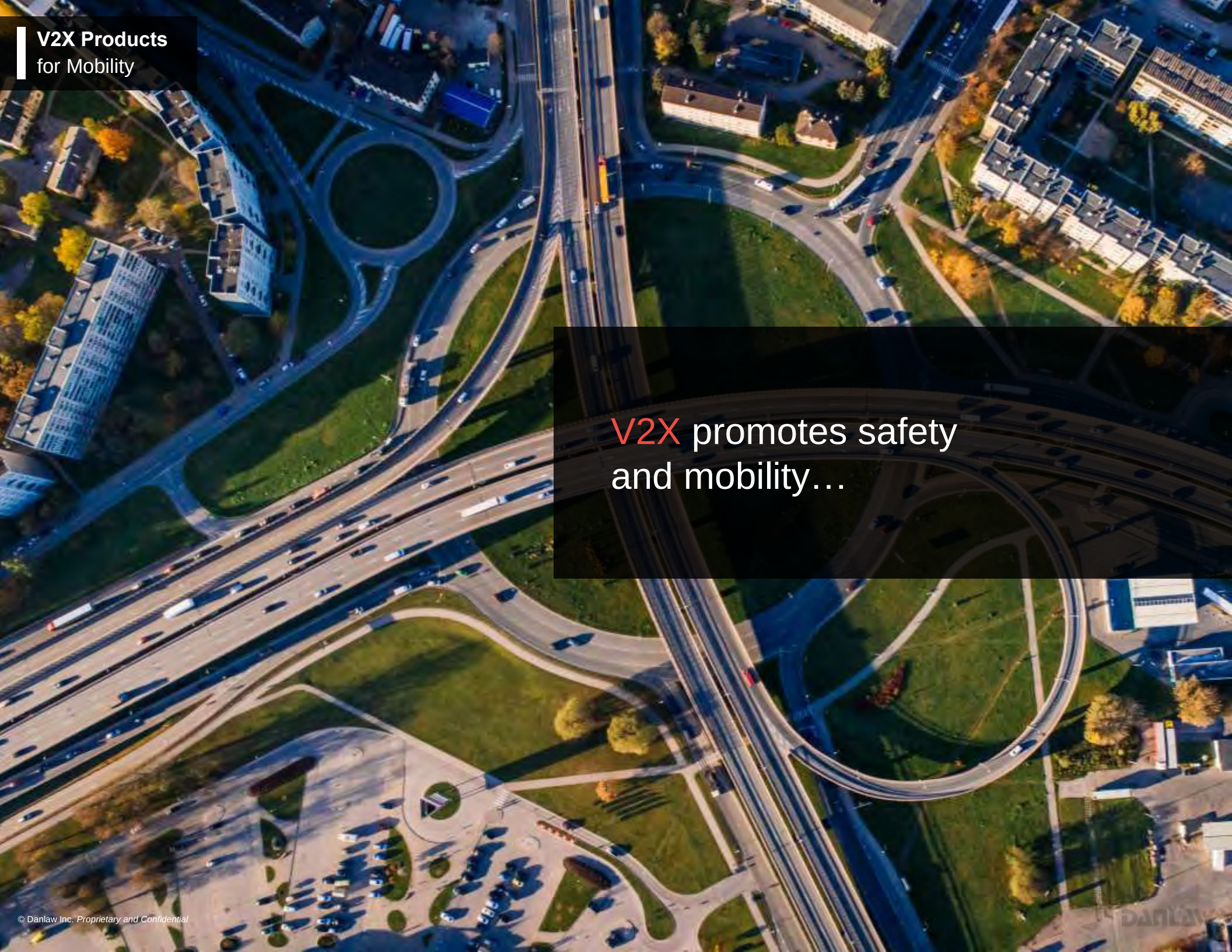
Who is pursing RUC?

2 states have legislation in place

Over half the states are actively exploring RUC



V2X Products
for Mobility

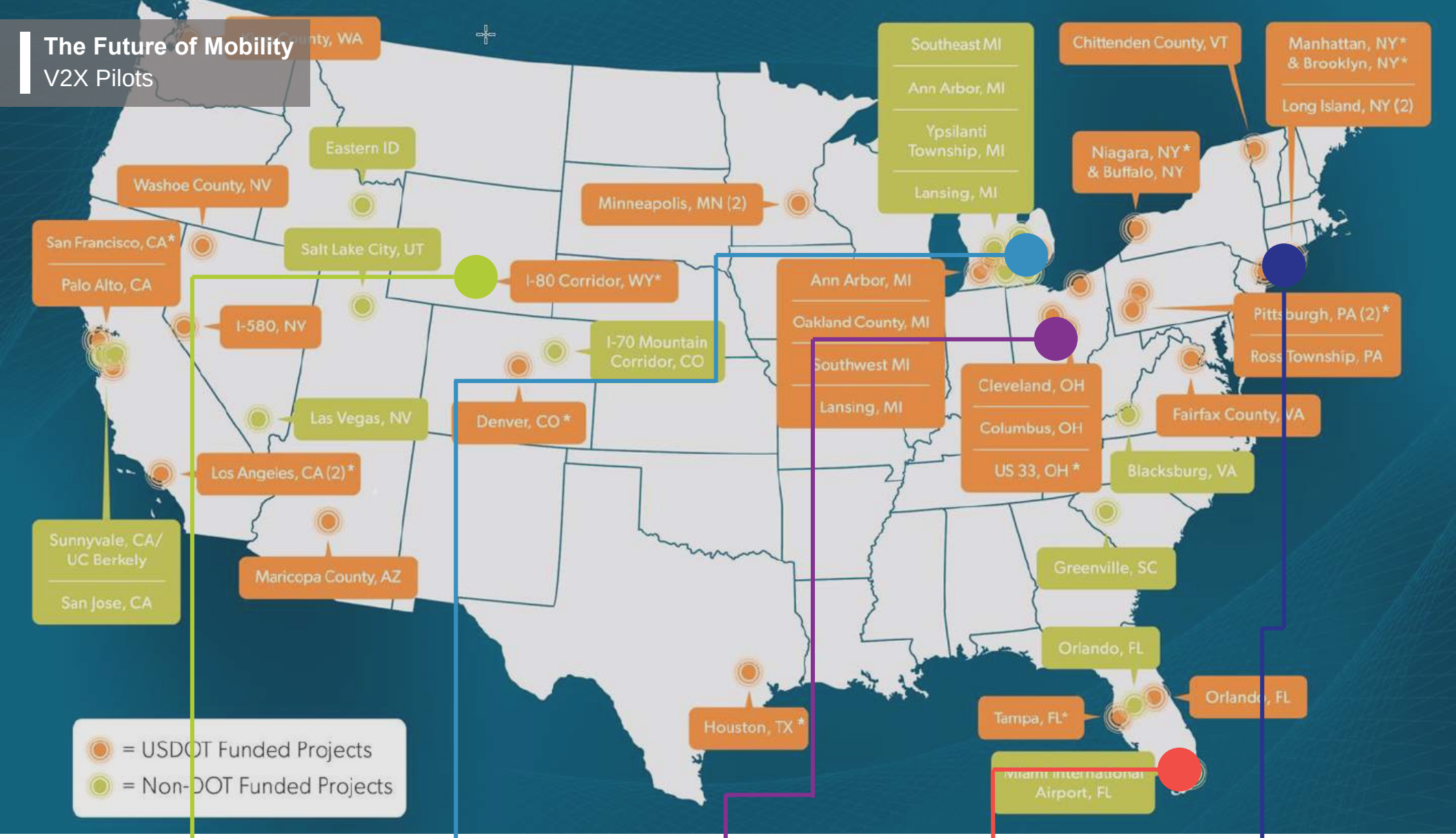


V2X promotes safety and mobility…

V2X
Vehicle to Everything

V2X –Vehicles, Infrastructure, People

The Future of Mobility
V2X Pilots



Wyoming	Metro Detroit	Columbus	Tampa	New York City
Commercial Vehicles Safety	UMTRI MCity	Comprehensive plan	Congestion relief, pedestrians	Urban canyons

DANLAW

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

COC
Certification
Operating
Council

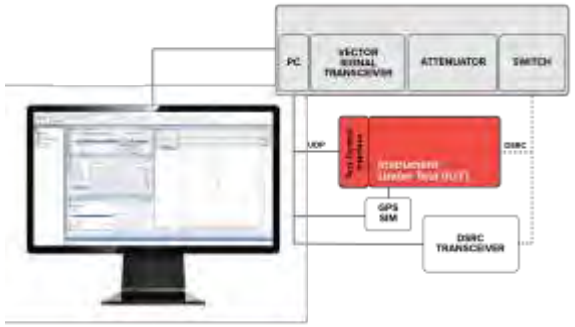
OMNIAIR
CONSORTIUM

May 7-11

Engineering Solutions – V2X
Development Tools

MxSuite

Core test system functionality allows users to include non DSRC vehicle functions for system integration test and validation.



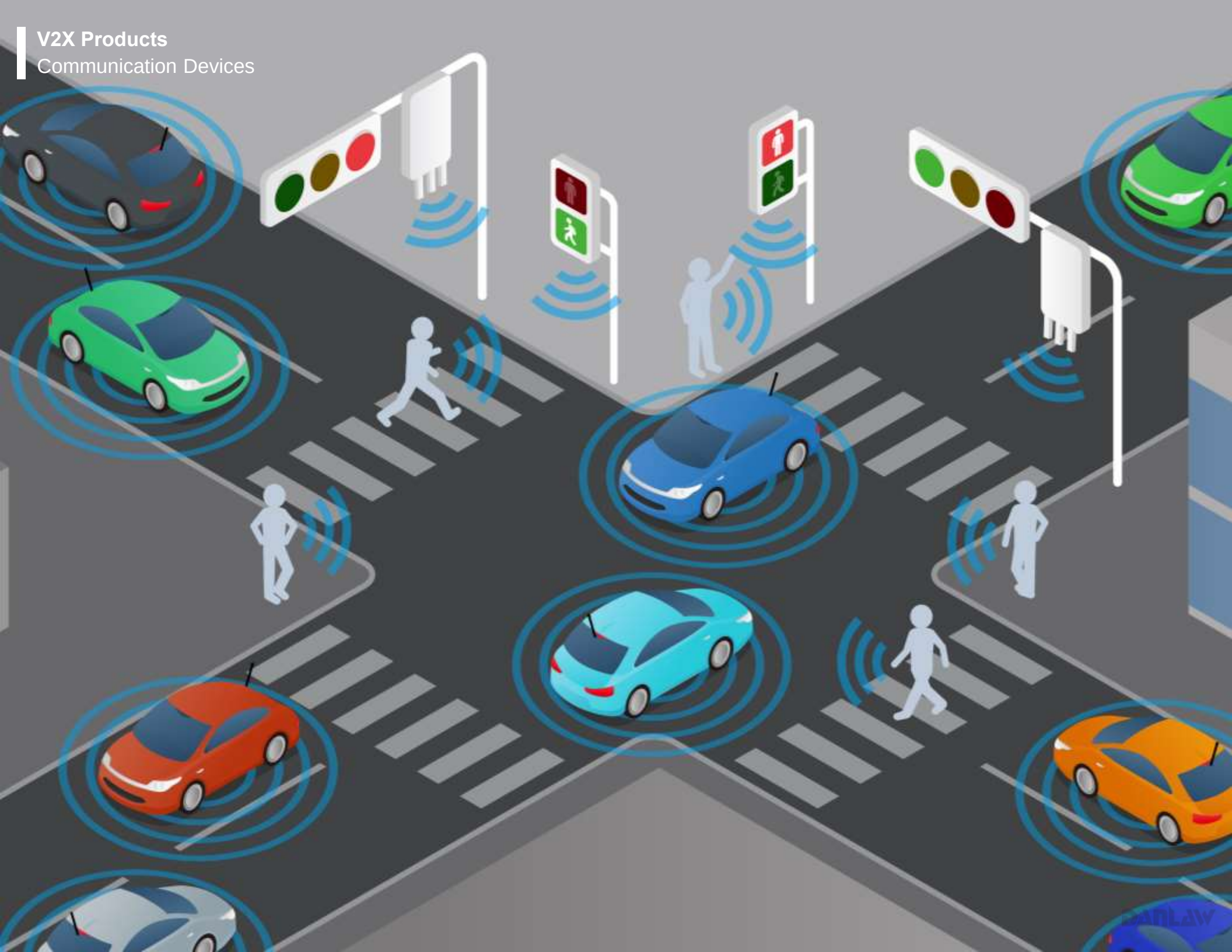
MxDSRC

Includes the test cases defined for the USDOT certification program allowing users to pre-certify systems significantly reducing certification time and cost.

MxDrive

Simulated mobility environment of DSRC nodes to test application on a PC (MIL or SIL) or on-target (HIL).

V2X Products
Communication Devices



On-board Unit (OBU)

Complete solution that collects real-time driving information from other vehicles and roadside equipment. Simplifies integration of connected vehicle functions for V2X pilots.

Through-Glass Antenna

Uses coupling pair to pass DSRC RF signals from the interior to the exterior of the vehicle and adjustable to any windshield angle.

The coupler eliminates the need to drill holes through the vehicle or pass cables through a window opening.

Roadside Unit (RSU)

This is the center of communication for OBUs in vehicles, traffic controller equipment and security certificate management.

V2X
Applications and Stack

V2V

Lane Change Warning / Assist
Emergency Electronic Brake Light
Blind Spot Warning
Forward Collision Warning

V2P

Pedestrian Safety

V2I

Oversize Vehicle Compliance

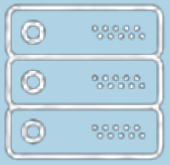
Over Height

Evacuation / Emergency Notification

Updates / Uploads

OTA Firmware Updates

Parameter Up / Down Loading



DSRC Protocol Stack

Runtime application environment and middleware to handle core V2X functions.

Join Us for **Demos & Drives** at 4pm!

Sign up for an in-vehicle demo of our V2X products at the front registration table.

Thank you.

Mike Carroll
VP Sales – Connected Car
MikeC@Danlawinc.com

Andrew Donaldson
Program Manager
AndrewD@Danlawinc.com

Corporate Headquarters
41131 Vincenti Ct.
Novi, MI 48375

MSC Software

Virtual Testing of AVs – The Need for Open Standards

Presented By:
April 25, 2018

PART OF HEXAGON

Motivation

Motivation

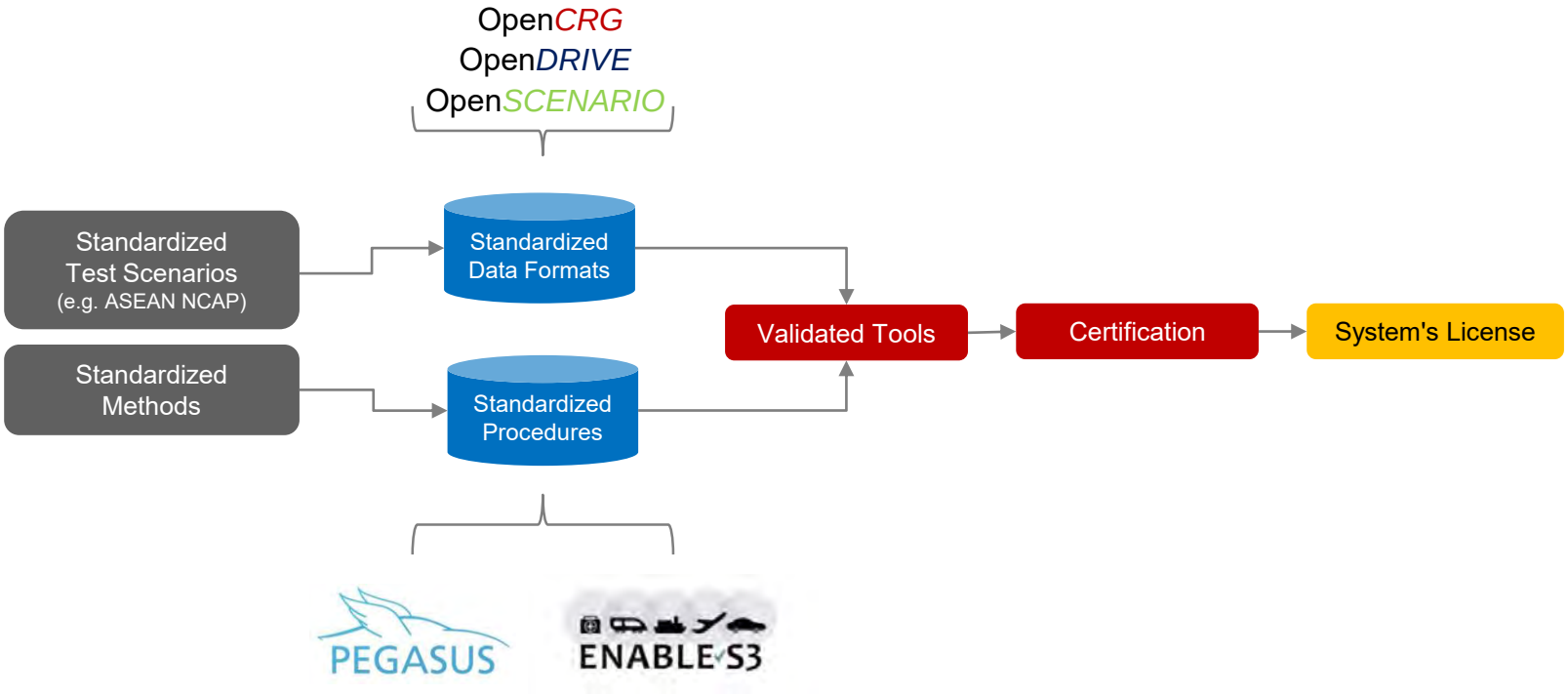
In order to avoid this...

Motivation

...We are doing this

Simulation-Based Certification

Standards & Validated Tools Required



Introduction

What is VTD?

Introduction

What is VTD?

VIRES Virtual Test Drive®

Partner in Standardization Initiatives:

OpenCRG

OpenDRIVE

OpenSCENARIO

Partner in Research Projects:

PEGASUS ENABLE-S3 + additional ones *(2 starting 2018)*

Partner in:

Auto Drive Challenge *(via MSC.Software)*

Simulation Workflow

Covering the Event Space

Simulation Workflow

Testing in Virtual Environments

Open Solutions

Standards Make Life a lot Easier...

Open Standards – not Open Source

- Open Source:
  - Open source is a way of developing and distributing software that gives permissions for what can be done with it
    - Sharing of knowledge, re-usable, limited protection of IP
    - Can facilitate innovation

- Open Standards:
  - Facilitates exchange of data, assuring a common set of requirements and verifiable
    - A blueprint and agreement on a specification
    - Examples are V2X communications standards

Standards for Environment Simulation

Inspired by VTD

OpenDRIVE

Network

2006+

OpenCRG

Surface

2008+

OpenSCENARIO

Maneuvers

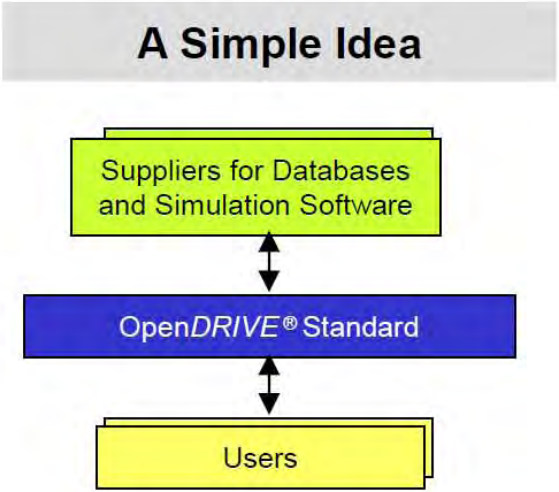
2016+

Static Content → | ← **Dynamic Content**

OpenDRIVE Background

- The OpenDRIVE® project started a several years ago when VIRES began building visual databases for various driving simulators
- In order to interface the databases with the vehicle dynamics or the autonomous traffic, an additional **description of a road network's logics** had to be delivered with each visual database.
- Working with different customers we were dealing with multiple formats to describe the same content.
- With the goal of facilitating data exchange between simulators and simulations, VIRES collaborated with the Daimler Driving Simulator to standardize the logical road description
- It is considered a de-facto standard in the simulation industry for description of road networks

OpenDRIVE



Benefits

- simplified exchange of road networks between simulators
- creation of database pools for multi-party projects
- selection from a broader range of suppliers

Elements

- road geometry (e.g. reference line, elevation, superelevation, lanes)
- signaling (e.g. signs, signals)
- road type and speed profile
- simplified road surface (e.g. materials, patches)
- infrastructure (e.g. tunnels, bridges)
- arbitrary objects
- variations (data sets)
- custom extensions (user data)

OpenDRIVE® features

- XML format
- hierarchical structure
- analytical definition of road geometry
  (plane elements, lateral / vertical profile, lane width etc.)
- various types of lanes
- junctions and junction groups
- logical inter-connection of lanes
- signs and signals incl. dependencies
- signal controllers (e.g. for junctions)
- road surface properties
- road and road-side objects
- user-defineable data beads

OpenDRIVE – Extensive usage

An Established Format

Listed Users (on *www.opendrive.org*)

- Audi Electronics Venture
- BMW Group Research and Technology
- Daimler
- Deutsches Zentrum für Luft- und Raumfahrt
- Fraunhofer – IVI
- Krauss-Maffei Wegmann
- MBtech – Mercedes-Benz technology
- Realtime technologies
- TESIS DYNAware
- Technische Universität München
- TrianGraphics
- VIRES Simulationstechnologie GmbH
- VTI – Swedish National Road and Transport Research Institute

and many more across the planet...

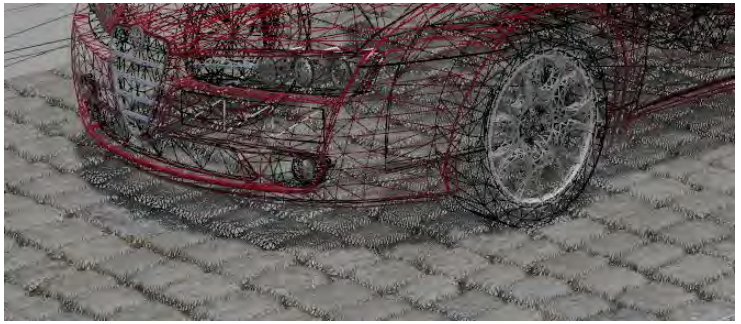
OpenCRG Background

- The OpenCRG® project started in October 2008
  - objective is to provide a series of open file formats and tools for the detailed description of road surfaces
  - The predecessor was a format called CRG
- which has been used internally for several years by Daimler AG. An entire suite of MATLAB® and FORTRAN tools had been developed for the handling, evaluation and generation of CRG data
- With OpenDRIVE, OpenCRG® now fills the gap between the macroscopic description of road networks and the microscopic description of road surfaces
- The early phase of the initiative was been funded by a series of German automotive OEMs

OpenCRG - Motivation

Simulation applications of

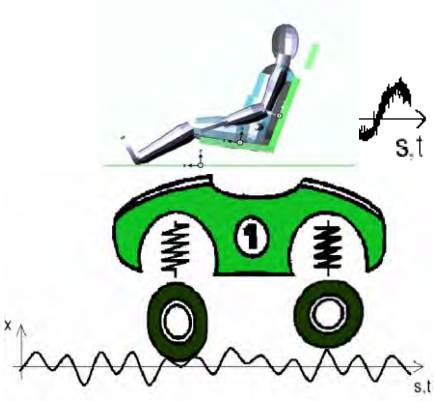
- Vehicle Handling,
- Ride Comfort, and
- Durability Load Profiles ask for a reliable and efficient road representations



Seat Model

Chassis Model

Tire Model/Road Excitations

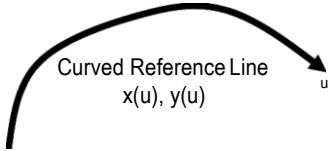


OpenCRG - Format

CRG Basic Idea

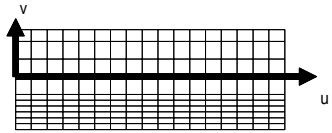
Curved Reference Line (Chord Line, Track)

- Defined in base plane by
  - Direction (heading, yaw angle)
- Optionally complemented by
  - Hilliness (slope, inclination, grade, pitch angle)
  - Cross Slope (superelevation, banking, cant, camber, roll angle)

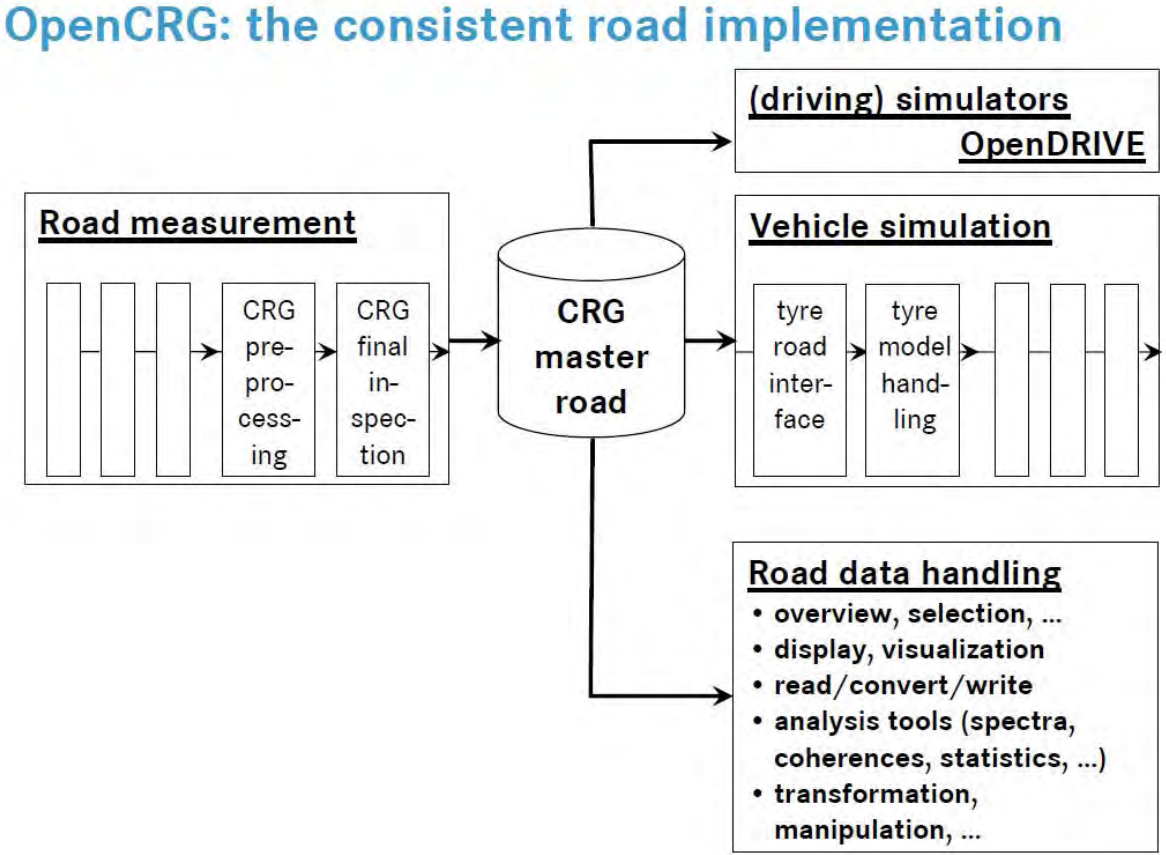


Regular Elevation Grid(locally orthogonal)

- Is a special form of a Regular Grid (a Curvilinear or Structured Grid)
- Defines the elevation in proximity of the *Reference Line*
- Columns are *Longitudinal Cuts* that are parallel to the *Reference Line*
- Rows are *Lateral Cuts* are orthogonal to the *Reference Line*



OpenCRG - Workflow

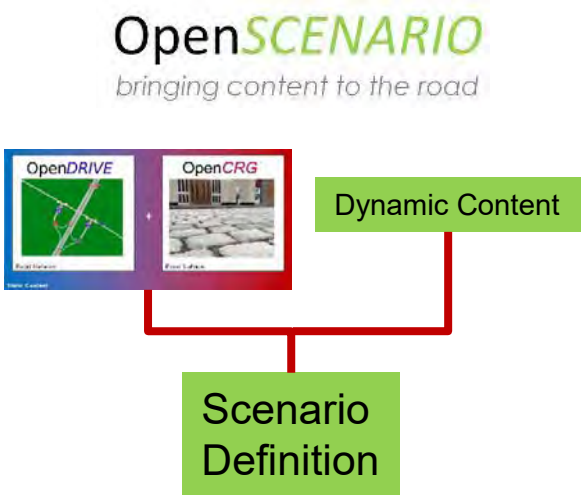


OpenCRG Features

- OpenCRG data sets are designed to describe patches of road surfaces in a very detailed manner, so that they may be used for:
  - tire simulation
  - vibration simulation
  - driving simulation
  - etc.
- Various ASCII/binary file formats with clear-text headers
  - handling of arbitrary scalar data vs. a reference grid (typically: elevation, friction coefficients etc.)
  - open source C-API for data handling and evaluation
  - open source MATLAB® API for data manipulation and generation

OpenScenario Background

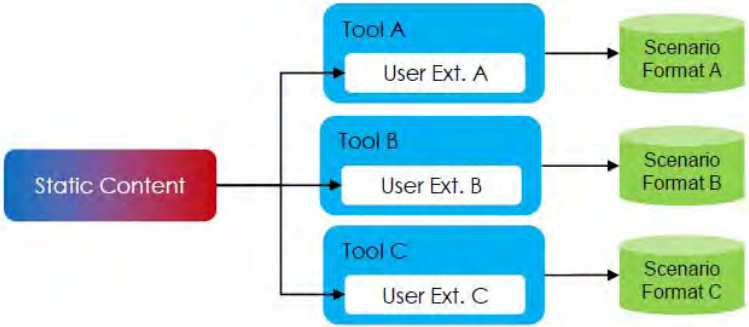
- OpenSCENARIO is an open file format for the description of dynamic contents in driving simulation applications
- The OpenSCENARIO® project started in late 2014, coming out of OpenDRIVE
- Static content of driving simulation environments can be described in the OpenDRIVE and OpenCRG standards
- In the OpenSCENARIO initiative, emphasis is on the dynamic content of driving simulation applications



OpenSCENARIO - Motivation

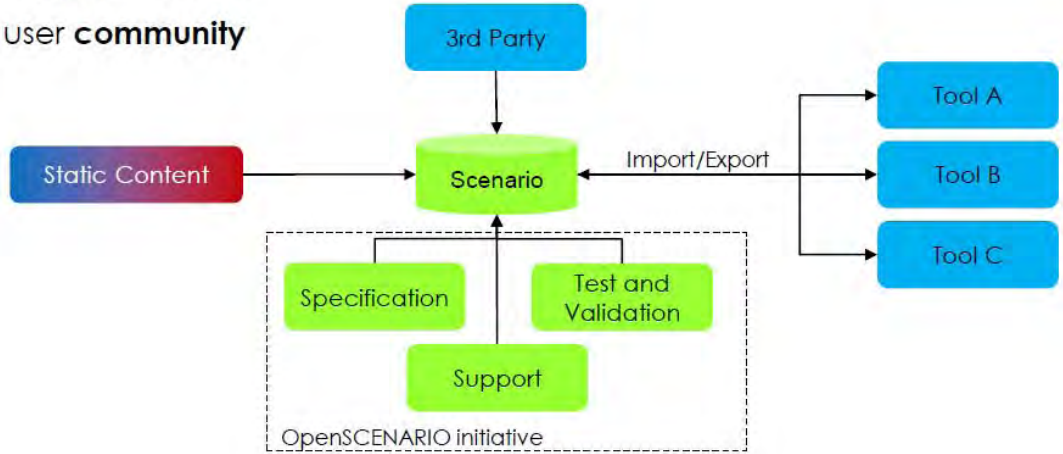
- ADAS functionality requires **extensive testing** in various environments
- **Feature sets** of various tools are highly different
- Each tool is well suited for its **specific purpose**
- **Migrating** secenarios from one tool to another one requires high effort
- Independent **3rd parties** (e.g. authorities) are not able to provide scenario definitions in a format compatible with multiple tools

- **Result:** Dynamic content may not yet be transfered in a standardized way and depends highly on the tools involved



OpenSCENARIO - Objectives

- Provide transferable XML **scenario definition** for various use cases
  - static content by reference
  - dynamic content
- Use **OpenDRIVE / OpenCRG** as basic layers
- Allow for independent content provision by 3rd parties
- Provide standardized / open **tool-sets** for validation of scenario definitions
- Establish **support** services
- Establish user **community**



OpenSCENARIO - Examples

Simple Steering

Two lane changes

Two lane changes & emergency brake

Lane change right/left

Overtaking

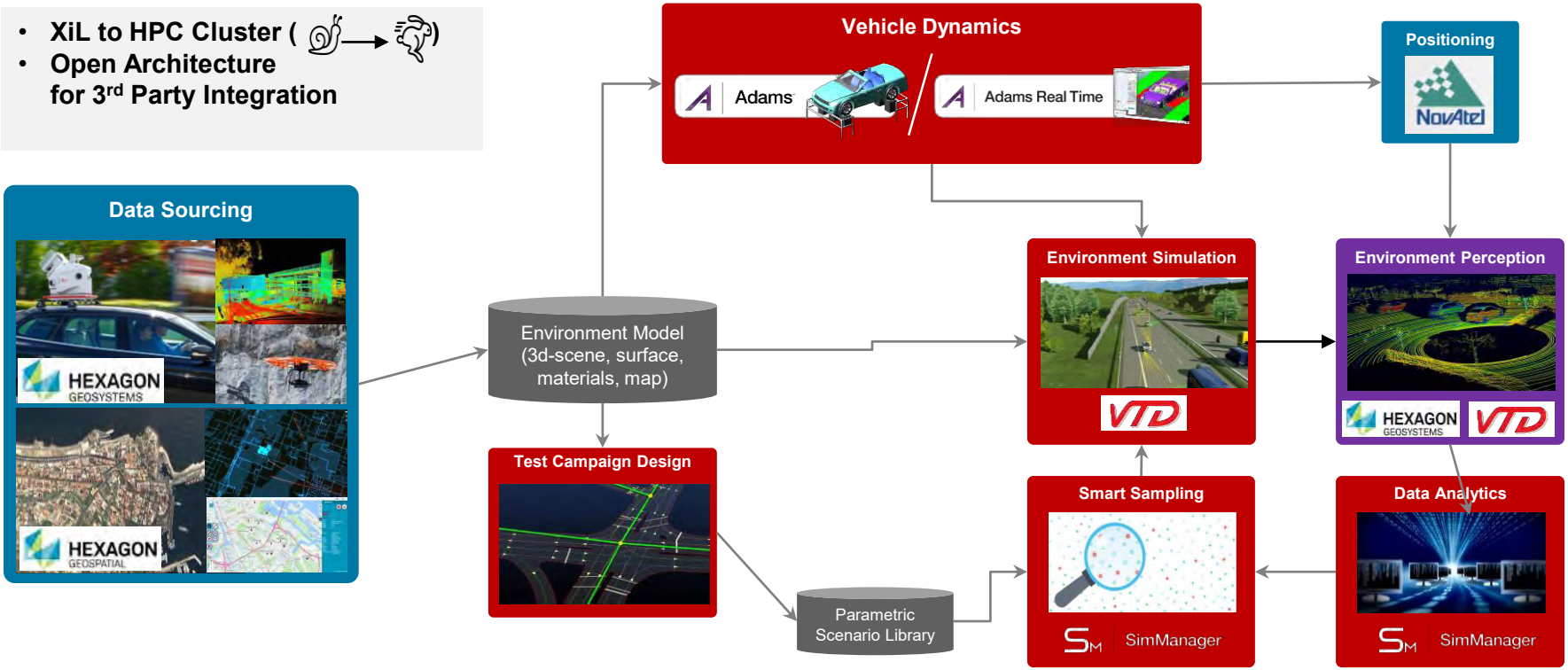
Traffic jam and corridor

Synergies

VTD and other MSC Products

Autonomous Vehicle Solution Portfolio

- XiL to HPC Cluster ( )
- Open Architecture for 3rd Party Integration

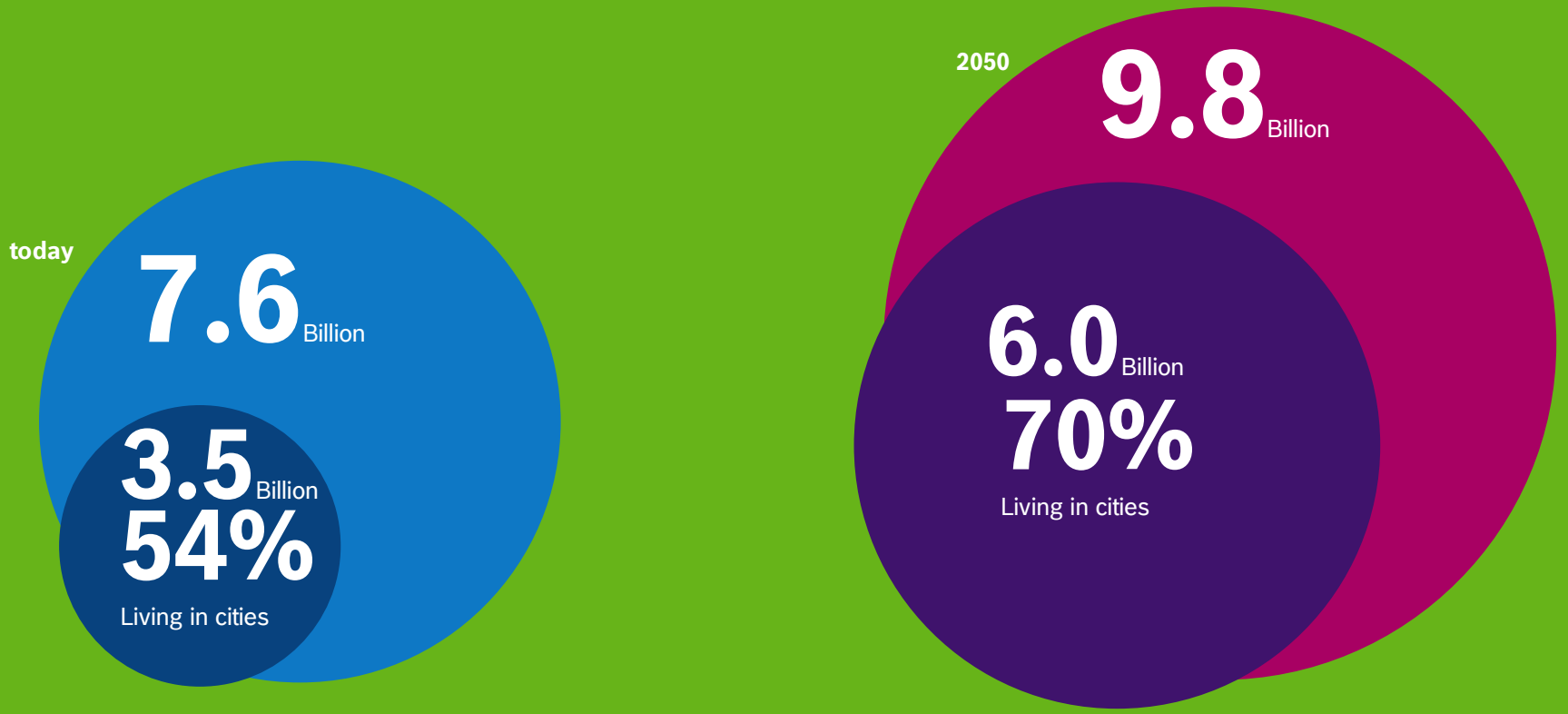


Thank You

MSC Software

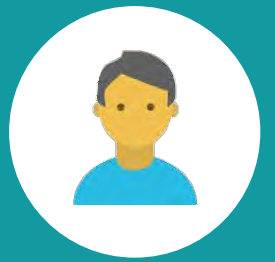
Building Smart Cities and Communities with Bosch

LIKE IT OR NOT…



BOSCH

BUT HOW DOES THIS CHANGE YOUR EVERYDAY LIFE?



THE HIGHER NEED FOR ENERGY WILL MAKE IT A EVEN MORE VALUABLE GOOD!

YOU CAN ORDER PIZZA ONLINE. BUT FOR A NEW ID? PAPERWORK!

BOSCH

MORE PEOPLE
MORE WASTE

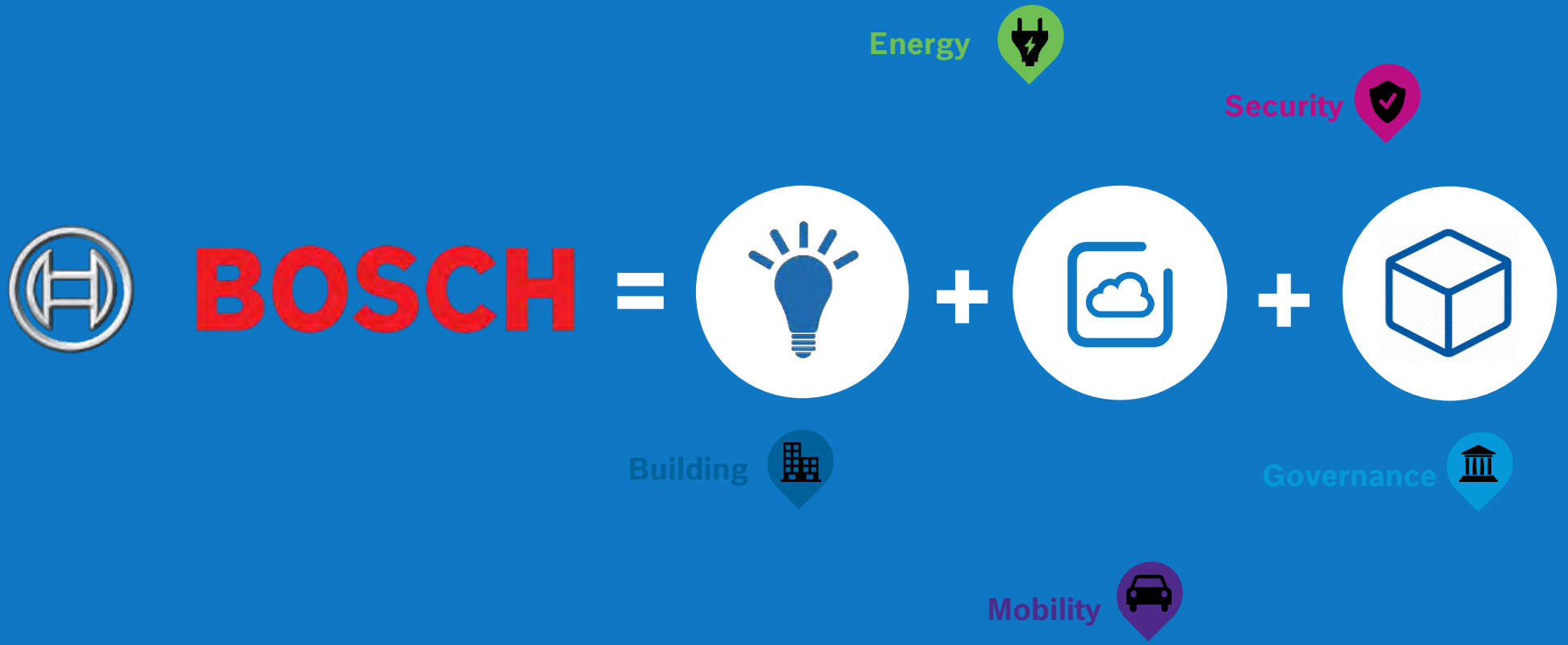
YOU WILL BE STUCK IN TRAFFIC JAM MORE THAN 46H PER YEAR

BOSCH

GOOD NEWS:
YOU DON'T HAVE TO LIKE THAT PART ABOUT URBANIZATION!

BOSCH


BOSCH


Energy
Security
BOSCH
=
+
+
Building
Governance
Mobility

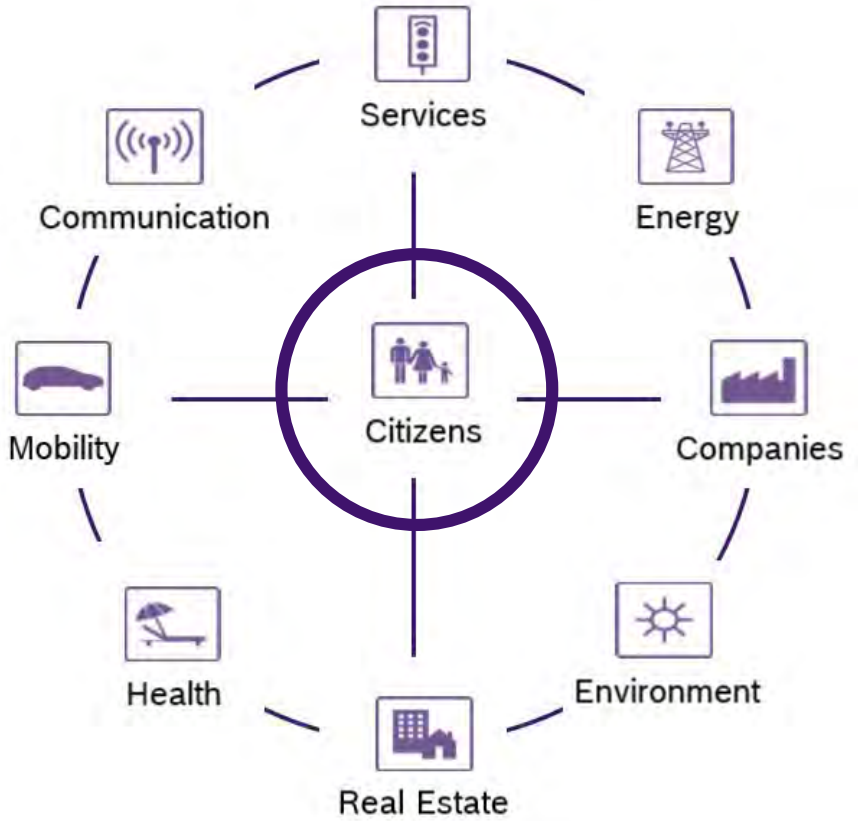
Building Smarter Cities and Communities

Smart City and Smart Community

Our **vision** for a smart city is to create an **interconnected ecosystem** that works to optimize **performance** and increase the **efficiency** and **quality of life.**

Smart City

- Retrofit/Legacy
- Responsible for sustainable development of **existing infrastructure**
- Initial focus on optimizing city for **mobility** of citizens and goods



Smart Community

- New Construction
- **New real estate project development** with focus on infrastructure, building and resident engagement
- **Differentiate project** from others by enhancing quality of life in local community

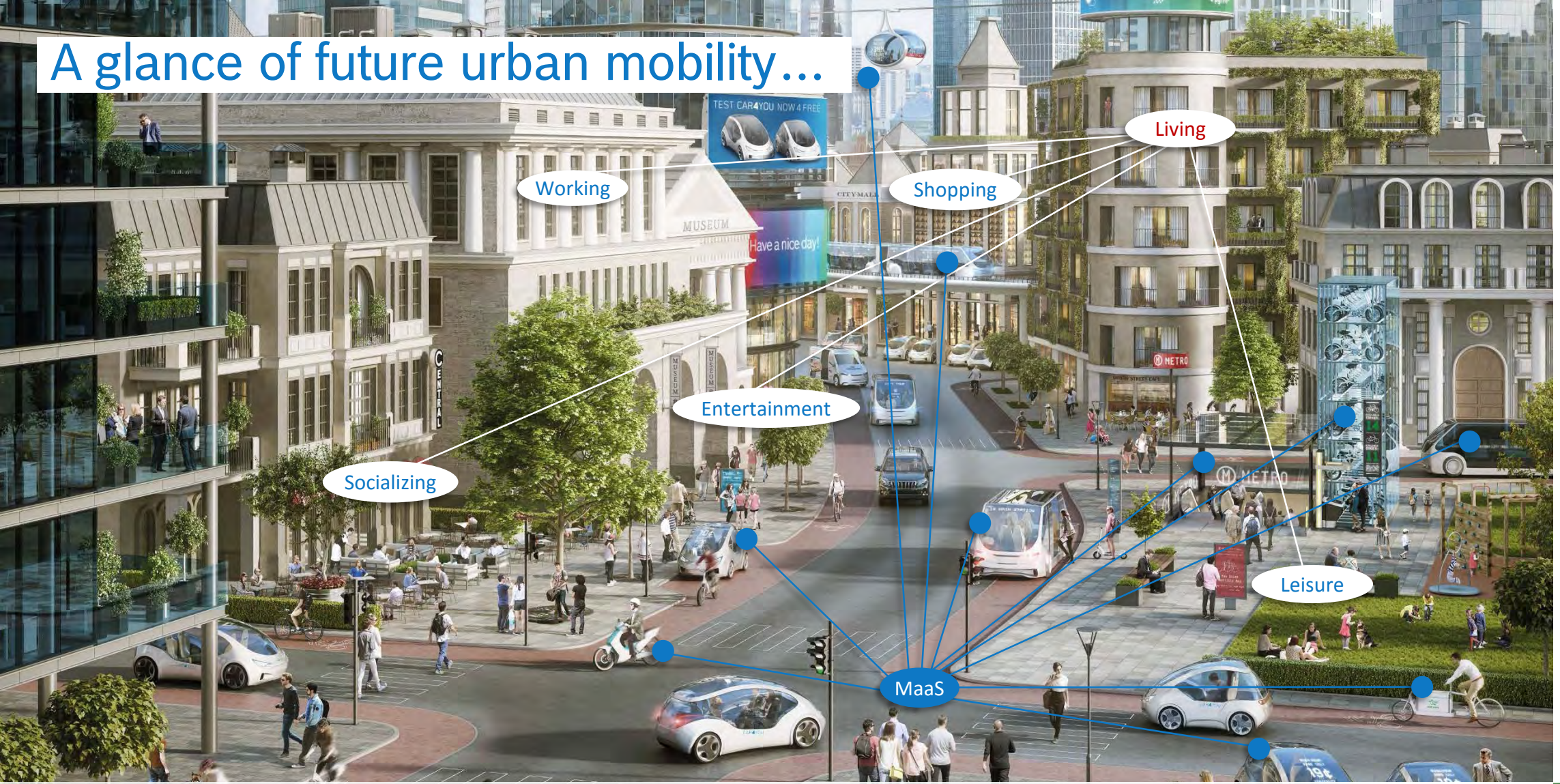
Bosch Mobility Solutions
Three Paths to Mobility of the Future

costs hybrid electric motor
roaming power electronics
e-bike **electrified** range
driving enjoyment charging infrastructure
market ramp-up battery
e-scooter smart charging plug-in

legislation assistance systems
emergency braking assistant
automated auto pilot
highway pilot sensors
redundancy electric steering
valet parking digital environment

augmented reality electronic horizon
internet of things smartphone integration
connected
vehicle to vehicle cloud
vehicle to infrastructure
services fleet management
entertainment eCall

A glance of future urban mobility…

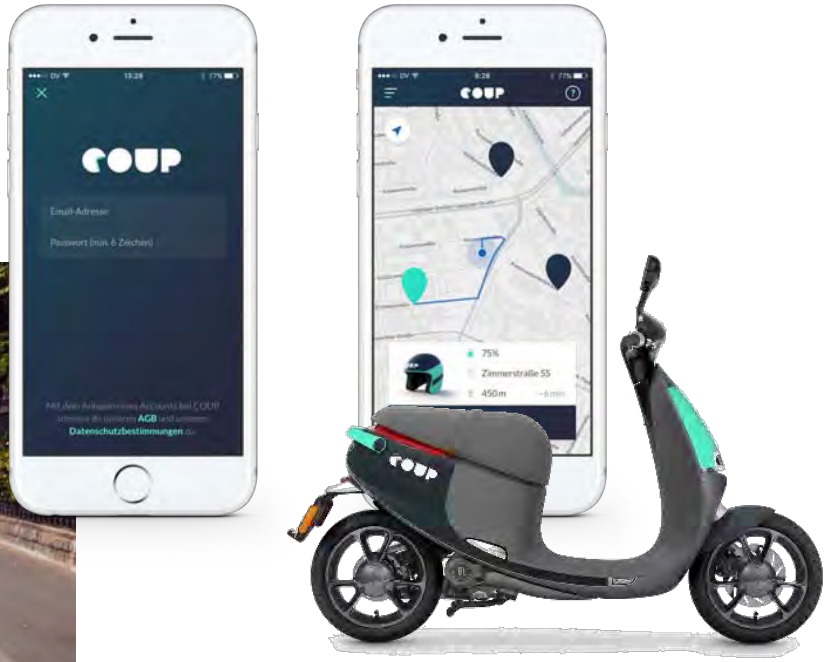


- Individual mobility will remain an important part of modern societies
- Mobility as a Service (MaaS) – all options to be easily chosen, used and paid

BOSCH

Mobility Solutions
COUP – eScooter sharing-service

- What is COUP?
  - COUP is an eScooter sharing-service. The eScooter can be rented at any time and anywhere for a personal ride within an urban area.
  - COUP was founded July 2016 in Berlin – 100% subsidiary of Robert Bosch



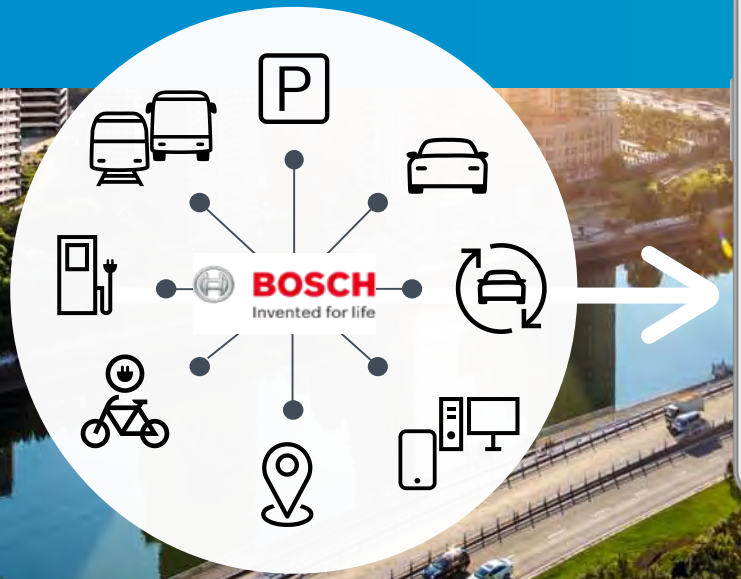
https://joincoup.com/en

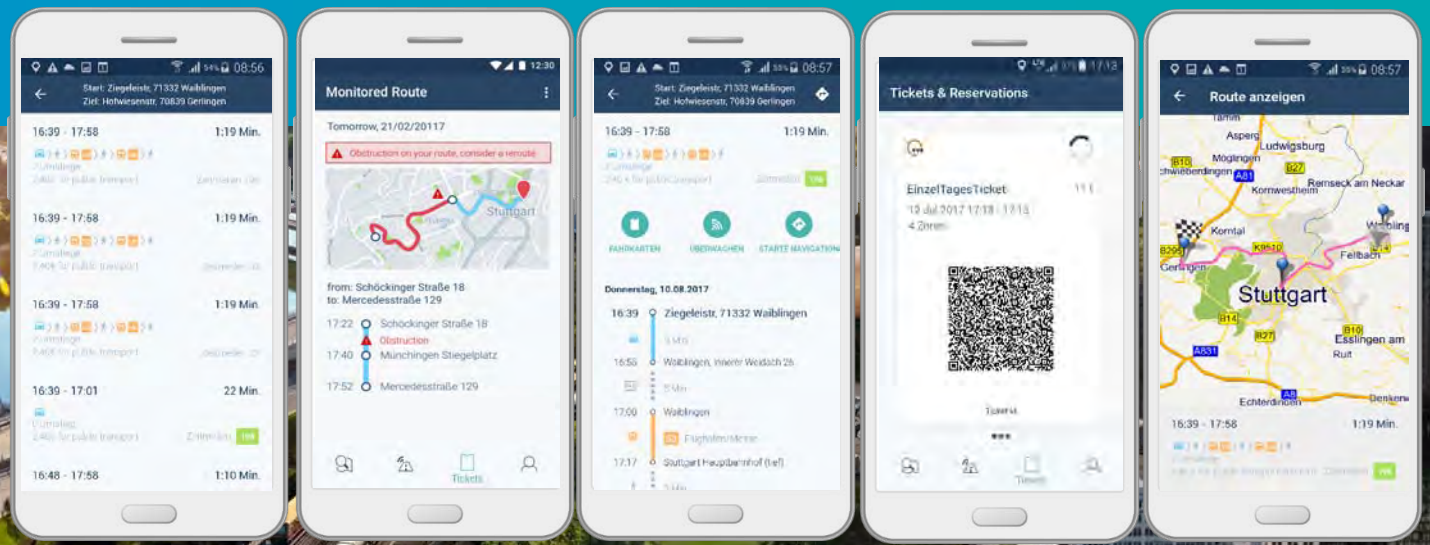
Mobiity Solutions
Intermodal commuting

Cities gain control

Mobility providers more frequented

Commuters arrive sooner





Route planning | Live data | Intermodal | Booking | Concierge

Connected Mobility Solutions Division

Our Vision....

Simplify future mobility!

Our Mission: we...

- **Shape the future of connected, shared and electric mobility**
- **Offer best-in-class solutions for key mobility demands, *notably new "Mobility as a Service" offerings***


Securing Smart Cities
with ESCRYPT

Thank you

Frank S. Sgambati
Director of Business Development – Smart Cities

BOSCH

PURE MOBILITY

ACTIVATING TECHNOLOGY THROUGH TESTING AND DEPLOYMENT

planetm

PROGRAM ORIGINS

In Spring 2016, the Michigan Economic Development Corporation (MEDC), Michigan Department of Transportation (MDOT), Business Leaders for Michigan, Detroit Regional Chamber and the State of Michigan Governor's Office created the PlanetM brand to represent collective mobility efforts across the state. Working in partnership with auto manufacturers, suppliers, universities and local partners, the PlanetM brand promotes Michigan's connected vehicle environment, and the idea that Michigan is the best place in the world for mobility advancements and development.

In Spring 2017, MEDC, MDOT and the Governor's Office decided to build on the early success of PlanetM by growing the brand beyond its awareness-focused advertising campaign into a full-service MEDC business development program. One that leverages a customer service-based model to:

- Deepen company relationships
- Make strategic connections
- Generate more intelligence on Michigan's mobility-focused supply base
- Create better coordination between Michigan's mobility assets
- Develop more new business development opportunities

THE ROAD AHEAD:
3 CORE BUSINESS DEVELOPMENT OFFERINGS

PlanetM Platform

To strengthen Michigan's position as the center for global mobility by leveraging **technology**, **companies** and **assets**

1. Technology
Activation

Meaning: Testing and Deployment Support

2. Company
Connections

Meaning Strategic Matchmaking and Lead Generation

3. Asset
Coordination

Meaning: Partnership Identification and Collaboration

NEW INITIATIVES LAUNCHED TO ALIGN WITH CORE BUSINESS DEVELOPMENT OFFERINGS

1. Technology Activation

Meaning: Testing and Deployment Support

- **Startup Grant Program**
  - **Testing**
  - **Pilots**
- **Project Kinetic (Mobility Pilot Facilitation)**

Note: The Startup Grant Program will be announced in June 2018.

2. Company Connections

Meaning: Strategic Matchmaking and Lead Generation

- **PlanetM Match Meetings**
- **PlanetM Awards**
- **PlanetM Pitch Competitions**
- **Mobility Hardware and Software Matchmaking**
- **PlanetM Landing Zone**

3. Asset Coordination

Meaning: Partner Identification and Collaboration

- **Michigan Delegation Leadership/Execution**
- **Michigan Visibility Tour Model for Venture Firms**
- **Governor's Silicon Valley Missions**
- **PlanetM Mission Control**
- **Michigan Mobility Steering Committee**
- **Michigan Visibility Tour Model for National Media**

APPENDIX

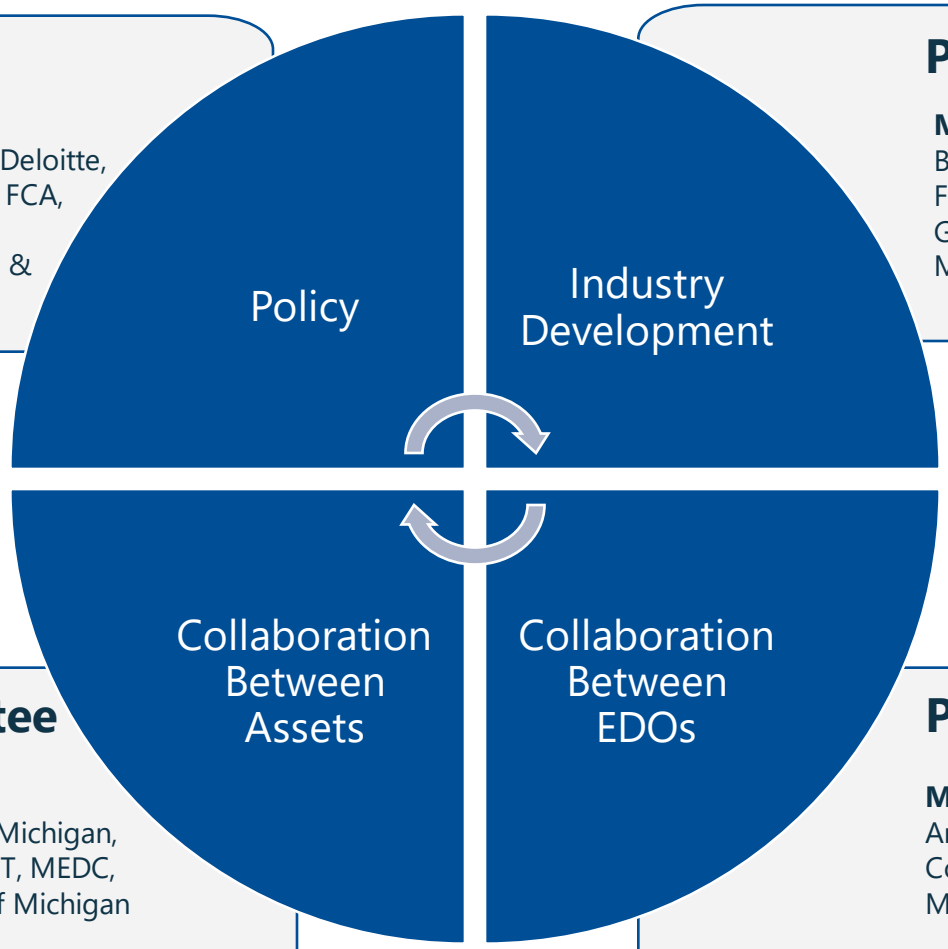
14 NEW BUSINESS DEVELOPMENT INITIATIVES

1. **PlanetM Match Meetings:** Events containing 50-500 prescheduled meetings between startups, automakers, suppliers, universities and investors based on interest area.
2. **PlanetM Awards:** This annual awards ceremony honors best-in-class mobility startups and technologies. Ceremony occurs during Detroit Auto Show.
3. **PlanetM Pitch Competitions:** PlanetM and Techstars Mobility have formerly partnered to organize periodic startup pitch competitions throughout the year.
4. **Michigan Delegation Leadership/Execution (CES, SXSW, etc):** PlanetM organizes the annual statewide plan to target mobility companies at the world's best trade shows.
5. **Michigan Visibility Tour Model for Venture Firms:** PlanetM coordinates engagements where out-state VCs are shown the region and new investment opportunities.
6. **Governor's Silicon Valley Missions:** PlanetM designs official Governor visits to Silicon Valley to build executive relationships, and generate economic development leads.
7. **PlanetM Mission Control:** PlanetM created this platform for SE Michigan economic developers to collaborate on mobility-focused economic development leads and projects.
8. **Michigan Mobility Steering Committee:** PlanetM created this platform for Michigan's mobility assets to share key project updates with one another on a monthly basis.
9. **Mobility Hardware and Software Supplier Matchmaking Services:** PlanetM brings California technology companies to Michigan to meet with Michigan manufacturers.
10. **Project Kinetic (Mobility Pilot Facilitation):** PlanetM brings together key public/private sector organization in a region to prioritize challenges and pinpoint solutions.
11. **Deployment Grant Program:** PlanetM launched this to get startups and growing tech companies to deploy more new technology within Michigan's city/state infrastructure.
12. **Testing Grant Program:** PlanetM and the University of Michigan are working to offer startups more access to Michigan proving grounds through discounted testing rates.
13. **PlanetM Landing Zone:** PlanetM, Detroit Chamber and WeWork partnered to create a mobility-focused physical space in Detroit where corporates/startups can collaborate
14. **Michigan Visibility Tour Model for National Media:** PlanetM brings in national media to share mobility assets, success stories within the state.

GOVERNOR'S NEW MOBILITY ADVISORY STRUCTURE

Council on Future Mobility

Membership: Public-Private
Continental, Citizens Insurance, City of Grand Rapids, Deloitte, MI Dept. of Insurance & Financial Services, MI-DTMB, FCA, Ford, GM, Hanover Insurance, Kent County, MDOT, MI House, MI Senate, MI State Police, MSU, Peracchio & Company, MI Secretary of State, Toyota



PlanetM Advisory Board

Membership: Public-Private
Bosch, Business Leaders for Michigan, Council on Future Mobility, EY, Fontinalis Partners, Ford, Governor's Office, May Mobility, MDOT, MEDC, MICHauto (Detroit Chamber), Renaissance VCF

MI Mobility Steering Committee

Membership: Public
American Center for Mobility, Business Leaders for Michigan, Council on Future Mobility, Governor's Office, MDOT, MEDC, MICHauto (Detroit Chamber), TARDEC, University of Michigan (Mcity and UMTRI)

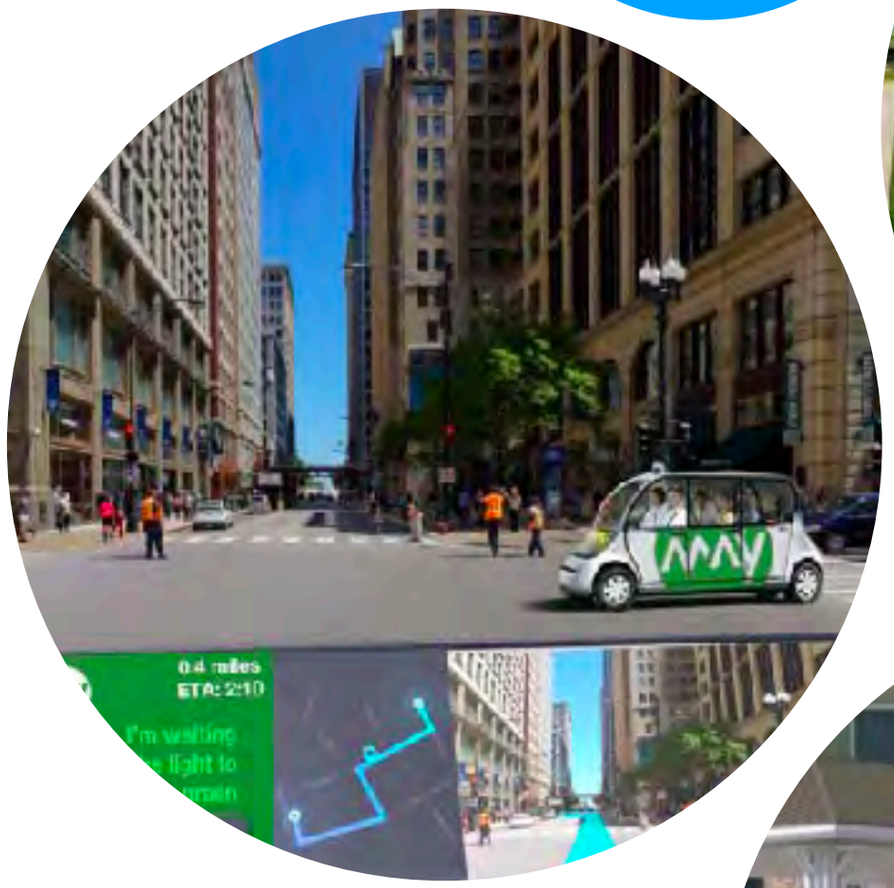
PlanetM Mission Control

Membership: Public
Ann Arbor Spark, Detroit Economic Growth Corporation, Detroit Chamber, Macomb County, MEDC, Oakland County, Wayne County

Connecting communities through self-driving micro transit

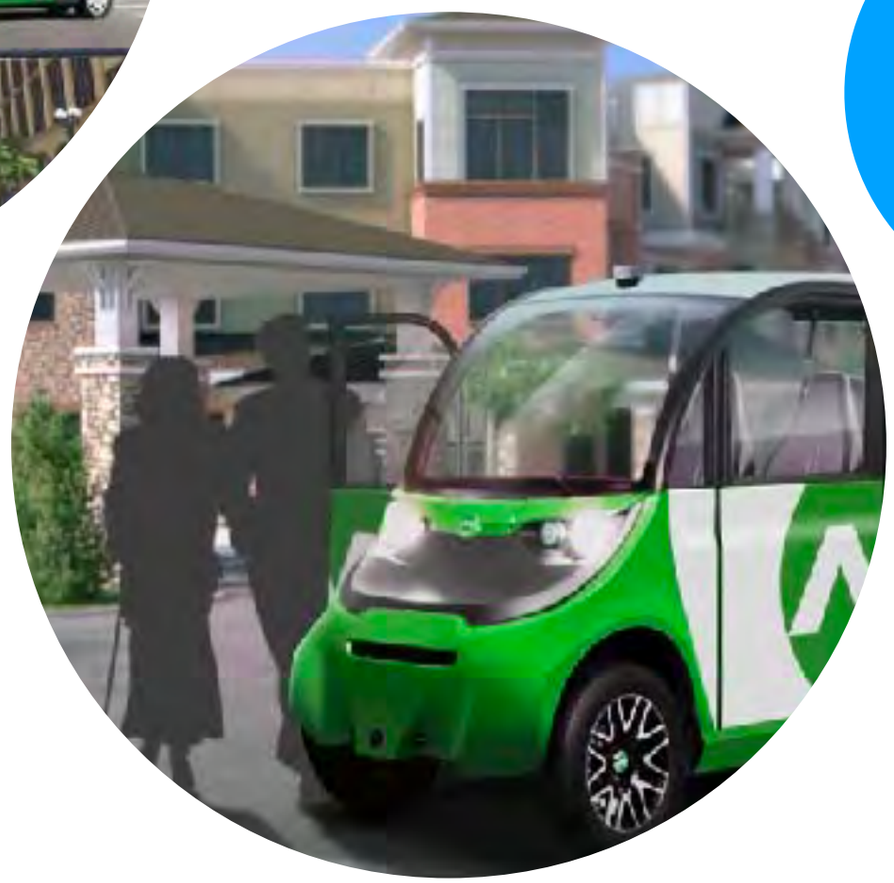
Steve Vozar
CTO, May Mobility

Rider Satisfaction & Convenience



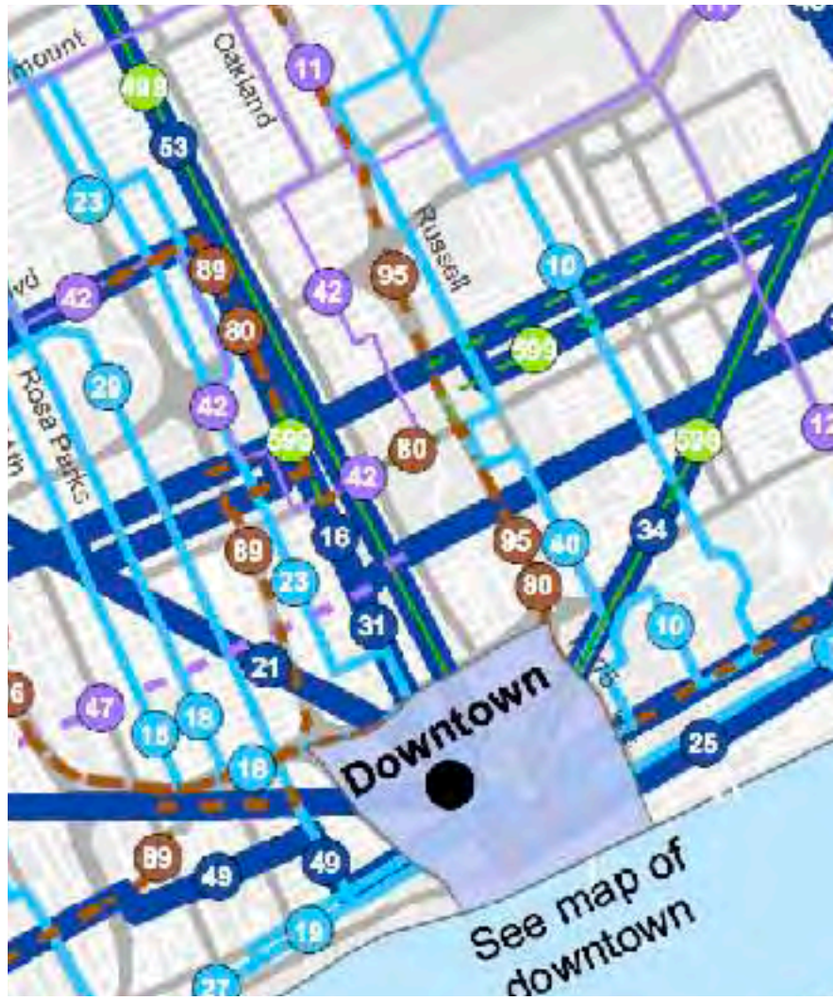
Digital and Physical Integration

Cost



Today- Buses

- Capital cost: ~$400k each
- Operating cost: $172/hr (NYC),
  $108/hr (Lansing, MI)
- Headway off peak or on minor routes 50-60 minutes
- Still more flexible than light rail



Today- Ride Hail

- More vehicle miles during peak.
- Waiting vehicles are circling
  Passenger occupancy rate 32-50%
- Don’t reduce vehicle ownership
  *Ride-hailing users are 6% **more** likely to own a car!*
- Non-egalitarian access
  College-educated, affluent twice as likely to use ride-hailing
- Negative impact on other transportation modes
  With 21% of affluent-skewed adults using ride-hailing, public transit reduced by 6%
- **Increase in Passenger Miles**
  A measure of economic activity

Possibly contentious (and interesting); more passenger miles drives commerce. People moving easily and freely, on its own, is good!

Automated Micro-Transit

- Larger number of smaller vehicles (vs bus) reduces headway
  Greater rider satisfaction
- Greater capacity (vs ride hail) reduces congestion
- Drive commerce at community scale
- **Technical difficulty**

National Association of City Transportation Officials,
Blueprint for Autonomous Urbanism

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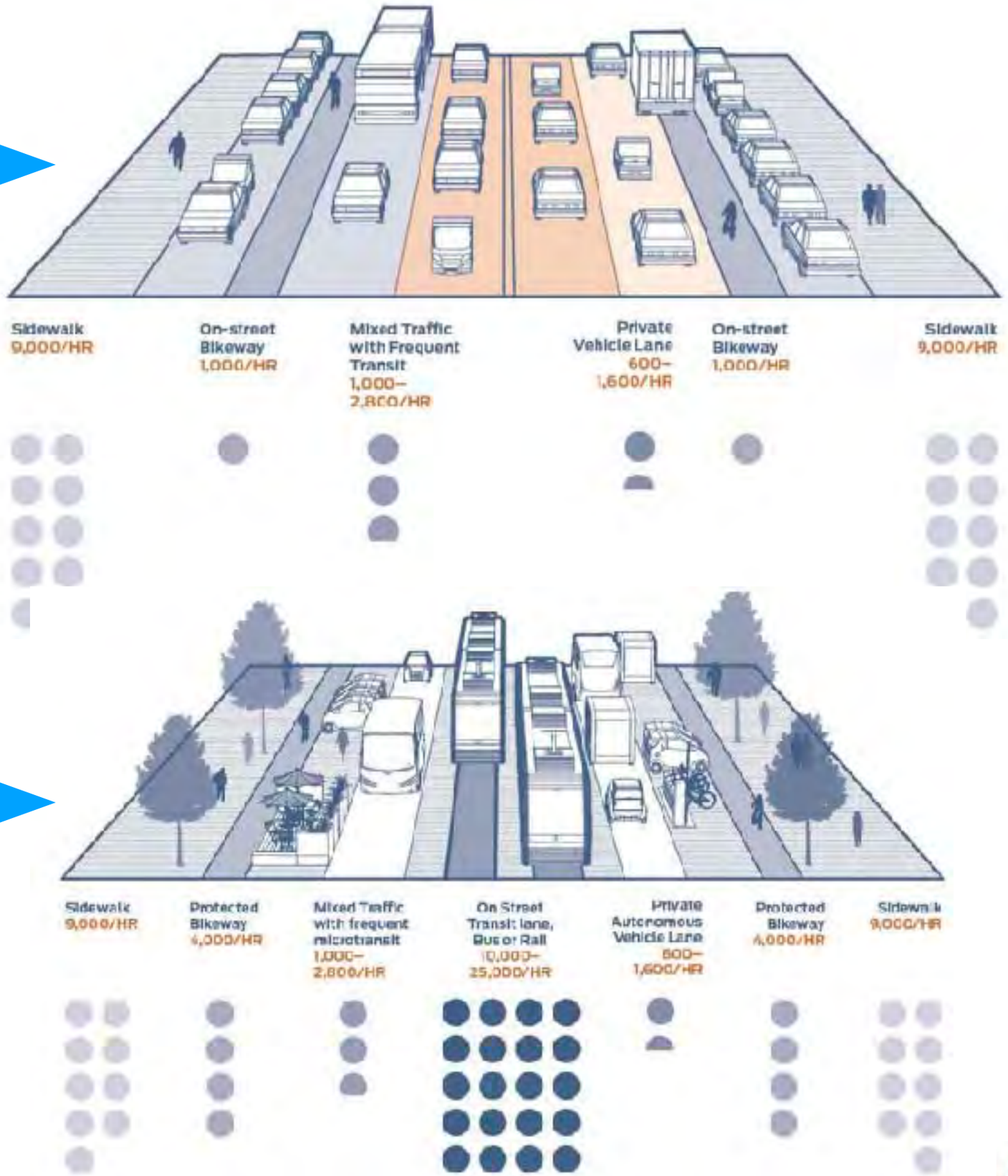
Blueprint for Autonomous Urbanism

Today



Goal

Technological Feasibility

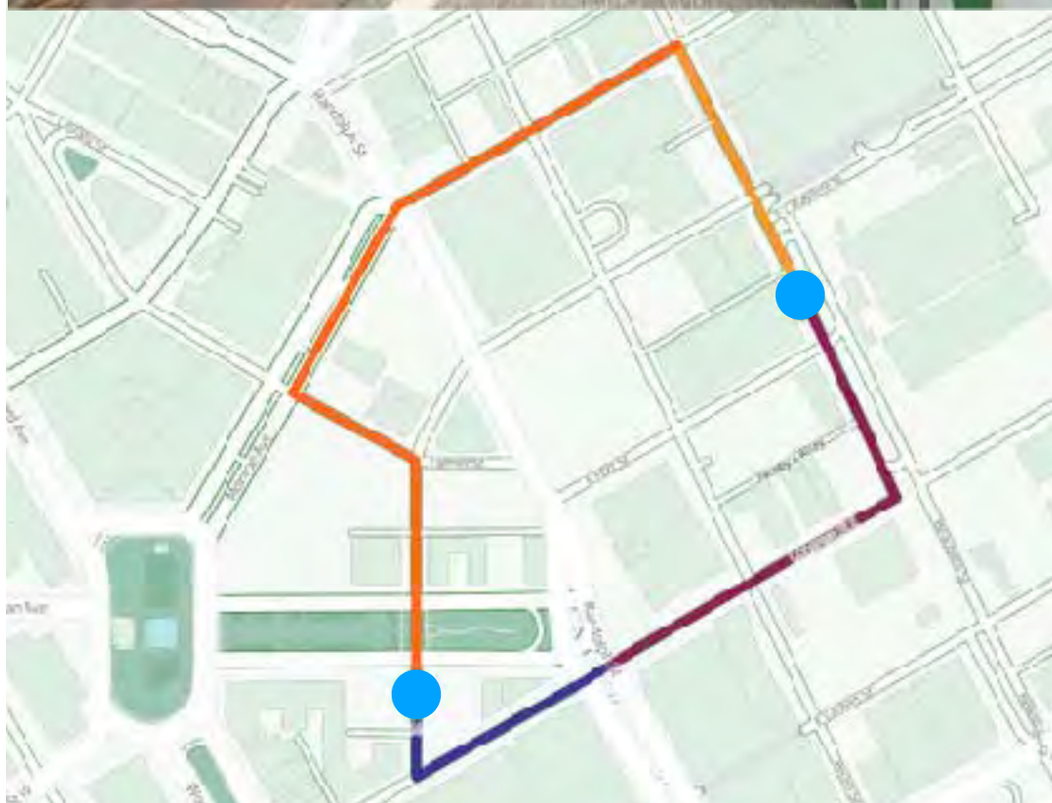
- Reliability: Meet/exceed human safety (1 fatality per 100M miles)
- Achievable in urban cities with state-of-art technology

Perception

Behavior

Starting Simple, but *Starting*

- Find routes that are…
  - Technically accessible
  - Economically viable
- Replace buses off-peak
  - Use existing BRT lanes
- Fixed-route circulators
  - Public roads, mixed traffic
  - 1km circulator



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may mobility