American Center for Mobility

Pennsylvania Transportation Engineering And Safety Conference
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Why Connected & Autonomous Vehicles (CAVs) at all ??

SAFETY

40,000 Fatalities in 2017
94 % of crashes are Human Error

Quality of Life & Environment

7 Billion Hours in Traffic

Over 1 Metric Ton of CO2 Emissions

Economy

Congestion costs $ 160 Billion per year
Transportation $1.4 Trillion Industry
63 Tons of Freight per year/per person

Where are We Going with Transportation Vehicles ?

Personal Mobility Vehicles of the Future ?

What is the Future of the Transportation Infrastructure ?

A system without Signals ?
A system without signs ?

Will Pavement marking be needed ?

New Highway Designs ?

Continuous vehicle platooning ?

CAVs are Leading the Transformation

➢ Saves Lives

➢ Saves Time

➢ Protects Environment

➢ Creates Value

➢ Changes Society

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CONNECTED. AUTOMATED. VALIDATED.

Working Definitions

- ## Connected Vehicle
  - A vehicle that is able to share and receive data with other vehicles, other road users, and the road infrastructure itself

- ## Autonomous Vehicle
  - A vehicle that uses onboard sensing, maps, and algorithms to operate the vehicle with no driver interaction required.

Connected + Automated = CAV

Connected & Automated Vehicles

- **Recent high profile crashes have garnered significant attention**

- **Significant technical and policy challenges remain including methods for testing and validation**

- **Voluntary standards will be needed for AVs and related equipment**

- **Technology is moving fast**
- **Education is critical**

How a Self-Driving Uber Killed a Pedestrian in Arizona

Waymo's Self-Driving Car Crash Revives Hard Questions

The American Center for Mobility | Willow Run, Ypsilanti, Michigan

Technology Validation is Challenging 'On Road'

Validation Challenges:

- ✓ "Unlimited" number of possible scenarios

- ✓ System-critical situations rarely happen while on road

- ✓ Scenarios often not easily reproducible while on road

- ✓ "Scenarios often too dangerous/complicated to test on road

Simulation → Test-track tests → Field tests
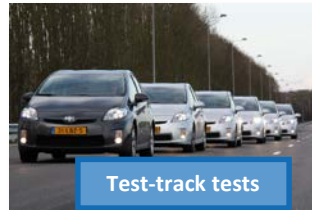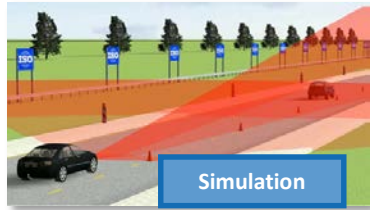
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prescan

The new testing challenge is cross-disciplinary

Needed: Next Generation Proving Ground

- **Traditional** proving grounds are typically designed for <u>single vehicle tests</u> such as:
  - ✓ Durability tests
  - ✓ Noise Vibration & Harshness (NVH) tests
  - ✓ Ride & handling tests
  - ✓ Skid tests
  - ✓ Etc.

- But for CAV's, **Next Generation Test Facilities** with additional capabilities are needed to:
  - ✓ Test the vehicle's environmental perception
  - ✓ Test the interaction of the vehicle with real world road-infrastructure
  - ✓ Test with large amounts of vehicles
  - ✓ Test with other types of road users
  - ✓ Test with multiple (competing) companies

What is the American Center for Mobility?

Non-profit, Purpose Built, Next Generation Automated Vehicle Proving Ground focused on:

1. Product development, testing and validating connected and automated vehicles and their security

2. Accelerating voluntary standards

3. Educating and training the workforce, public, and tech sector

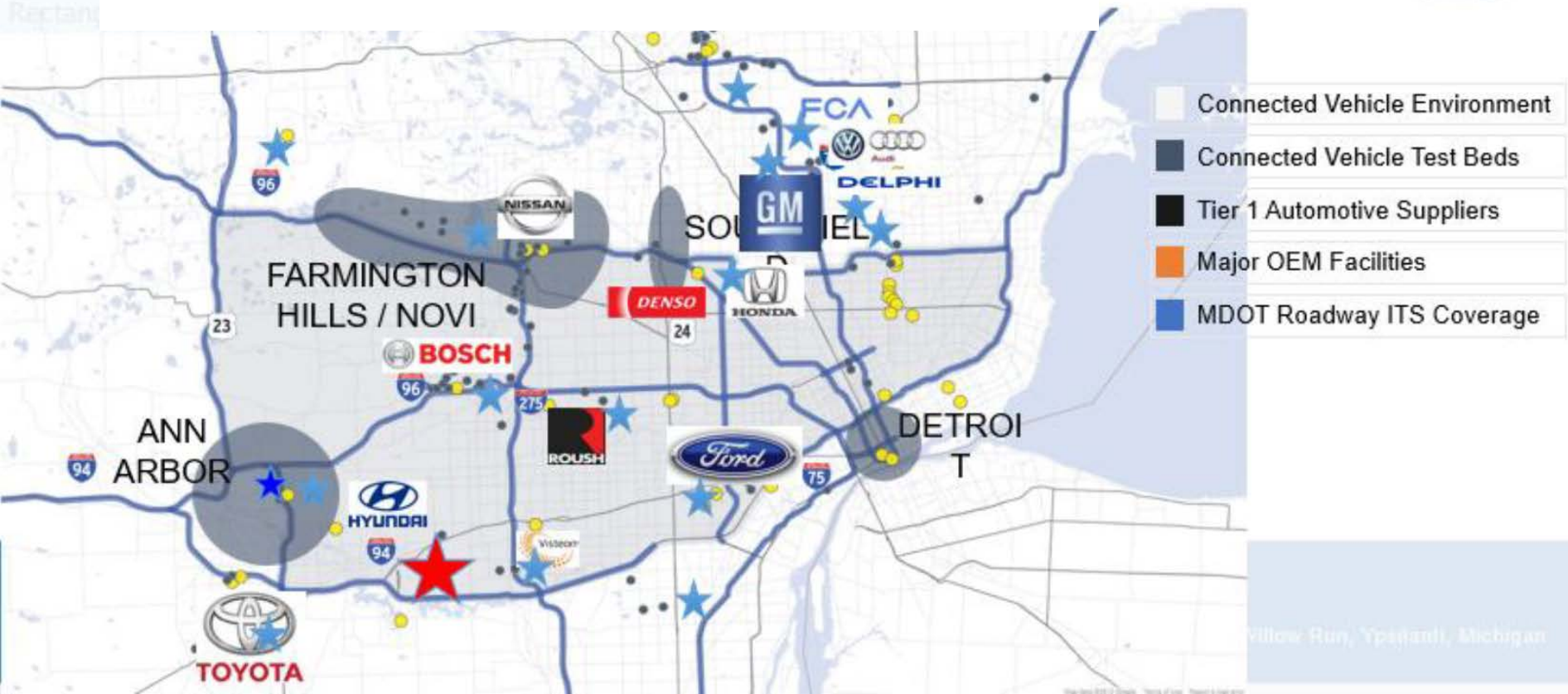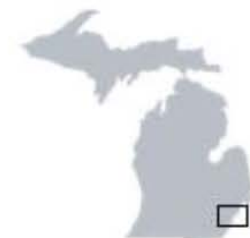CONTINUING THE SPIRIT OF INNOVATION AT WILLOW RUN

TESTING | STANDARDS | EDUCATION

The American Center for Mobility | Willow Run, Ypsilanti, Michigan

Why Michigan, why now?
Southeast Michigan Auto Industry

ACM – Industry Investors

Total of 110 M$ invested by State and Industry

ACM – Enabling Partners

intertek
Total Quality. Assured.

Track Operations and Testing Services

AT&T

Exclusive Cellular Provider (5G Pilot coming)

Microsoft

Data Manager and Cloud Provider

Siemens PLM Software

tass international

Simulation & Engineering services

SIEMENS
Ingenuity for life

Siemens Mobility Corporation

Signal and Communications Equipment

WILLOW RUN

The American Center for Mobility | Willow Run, Ypsilanti, Michigan
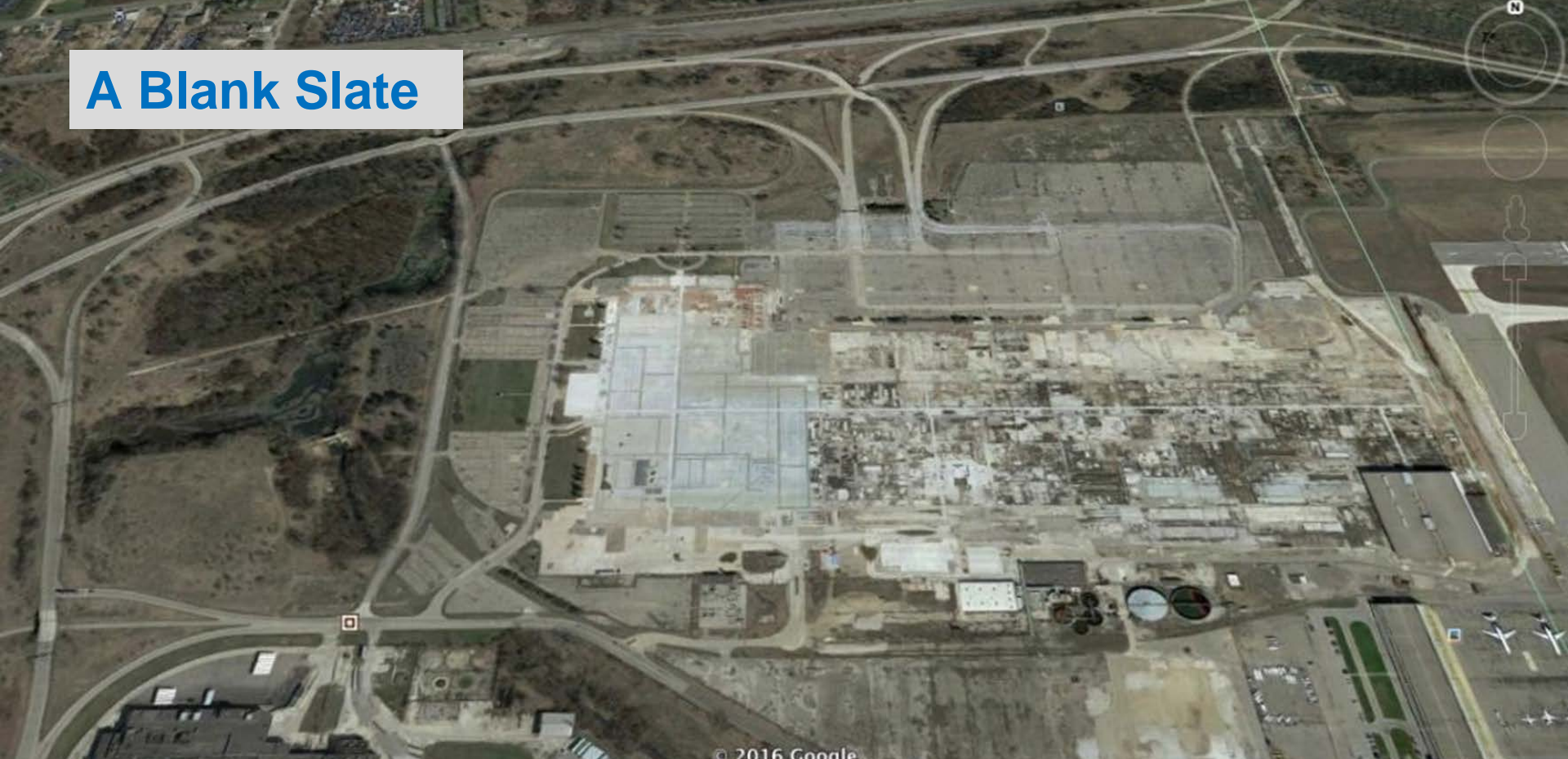
Willow Run - a history of innovation

A Blank Slate

The American Center for Mobility | Willow Run, Ypsilanti, Michigan

Pillars of Activities
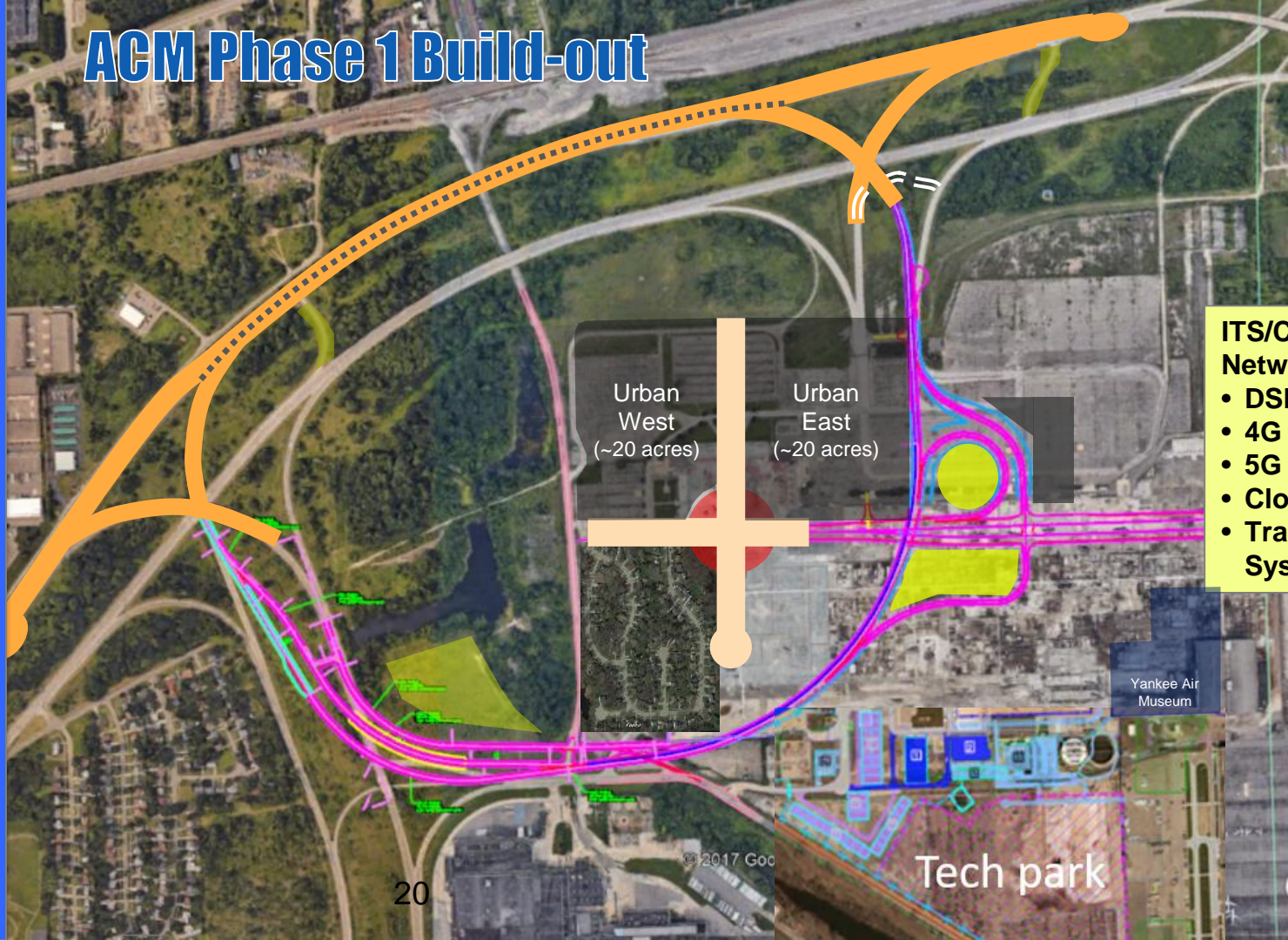

TESTING

STANDARDS

EDUCATION

ACM Phase 1 Build-out

Real world test infrastructure:

- 2.5 mile Highway Speed loop

- Full size Interchange

- 1.5 mile two lane arterial

- Triple overpasses

- 700' curved tunnel

- 6 lane Boulevard

Urban West (~20 acres)

Urban East (~20 acres)

ITS/Comm Networks:
- DSRC
- 4G LTE
- 5G (tbd)
- Cloud
- Traffic signal System

Yankee Air Museum

Tech park

20

©2017 Goo

ITS /Comm Network

AMERICAN CENTER FOR MOBILITY AT WILLOW RUN

Intelligent Transportation System Phase 1A Final Layout
Prepared By: WSP
Feb 28 2018

LEGEND

6 x		Wifi Access Points — Cisco Aironet 1560
21 x		CCTV Camera — Cohu HD Rba
12 x		5.9 Ghz DSRC Road Side Unit — Lear Locomate Roadstar RSU
		Dynamic Lane Control Signs (Future)
14 x		Field Ethernet Switch — Alcatel Lucent OS6855-U24X
7 x		Barrier Gate System — Hy Security
2 x		Barrier Gate System with Intercom/Camera — Hy Security
		ACM Guard Shack
		Main Gate
4 x		90' SPUN CONCRETE POLE
2 x		TRAFFIC SIGNAL MAST ARM POLE
5 x		40' STRAIN POLE
16 x		40' ROADWAY LIGHTING POLE - Light Emitting Diode (LED) - Wireless Control — Eaton - XNV2 LEDCIMCON - Lighting Controls - High Pressure Sodium (HPS) — Eaton - OVZ Drop Lanz Refractor
14 x		Tunnel Lights LED — Holophane - TNLED 9 4K 1 AS CLN DGRA S DM F1
1 x		Traffic Signal Controller — Siemens m-60 Traffic Signal Controller
		96 STRAND FIBER OPTIC CABLE

BUILDINGS

1. STG 1B (FUTURE)
2. STG 1A
3. STG 2 (FUTURE)
4. STG 3 (FUTURE)
5. MAINTENANCE BUILDING
6. TEMPORARY OPERATION CENTER LTG.
7. 1A
8. LTG 1B (FUTURE)

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wsp
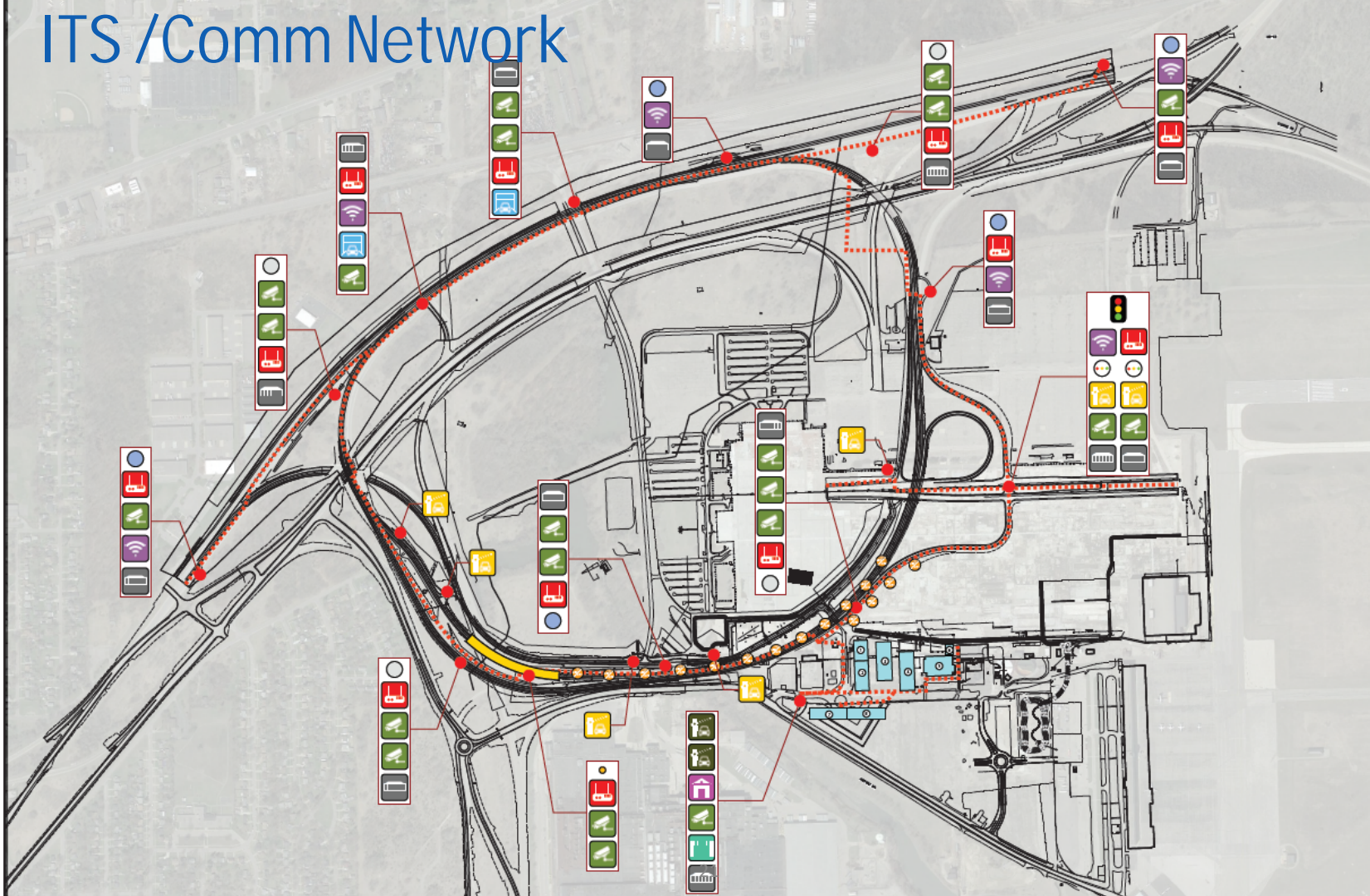
Safe validation must include a structured combination of three methodologies

Controlled track testing

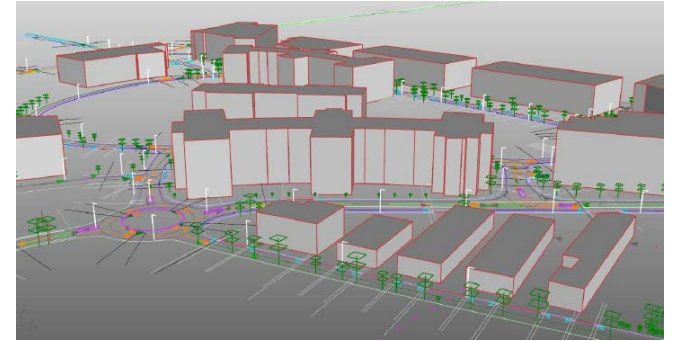
Computer Simulation - prescan

On-road testing & operation

Test environments – simulated

3D Mapping Solutions – ultraHD point cloud, color imagery

Siemens PLM / TASS PreScan

Data Management & Analytics Platform (DMAP)

Microsoft Azure

Scenario development

Data segregation / access control
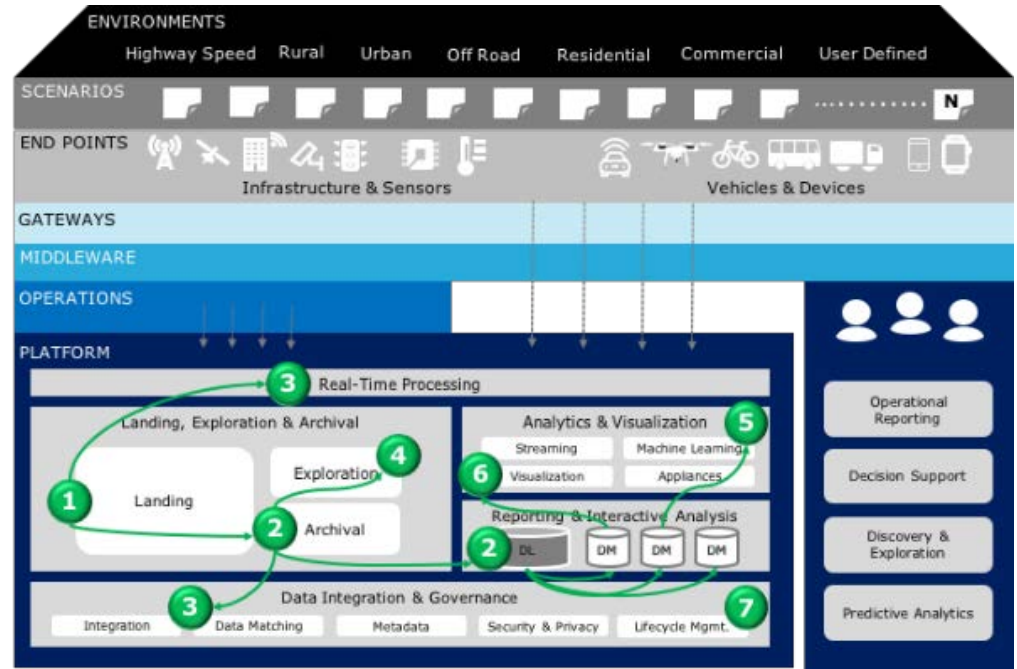
Decreased development cycle time

Visualization

On-track testing

Public-road data collection

Evaluate CAV safety, energy efficiency, advanced control algorithms in controlled and real-world settings

Single vehicle or small fleet experiments

Pillars of Activities

TESTING

STANDARDS

EDUCATION

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AV Validation – Policy & Standards

Unanswered questions:

How safe is safe enough?

When is a test vehicle safe enough to go out on the public roads?

How will we validate that an AV is ready for public sale and use?

How are in-service updates, repairs, and aftermarket solutions validated?

Industry and government collaborate on standards

technical expertise

Next Generation Proving Grounds accelerate this process

voluntary standards

regulation

Pillars of Activities

TESTING

STANDARDS

SAE INTERNATIONAL

ite

IEEE

EDUCATION

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ACM Academic Consortium

University of Detroit Mercy · Oakland University · Wayne State · EMU Eastern Michigan University · M Dearborn

Washtenaw Community College · Michigan State University · University of Michigan · Michigan Technological University 1885 · Kettering University

Lawrence Technological University · Grand Valley State University · Western Michigan University · WCCD Wayne County Community College District · Macomb Community College

Four Key Education Needs

Workforce

- Professional development
- "NextTraining" for displaced workers
- Veterans Next Training
- Ongoing Training & Certification
- "Boot camp"

Public & K-12

- General Public
- Seniors
- STEM Students
- Disabled & Underserved Communities
- Dealers
- First Responders

Higher Ed

- Direct hands-on experience for students
- Co-ops, internships, summer jobs, recruitment opportunities

R&D

- Collaboration in pre-competitive research
- Joint funding opportunities and research

Original

1944

Revised

2003

Reclaimed

2016

Imagery Date: 4/7/2017   42°14'27.99" N   83°33'22.52" W   elev 720 ft   eye alt 3602 ft
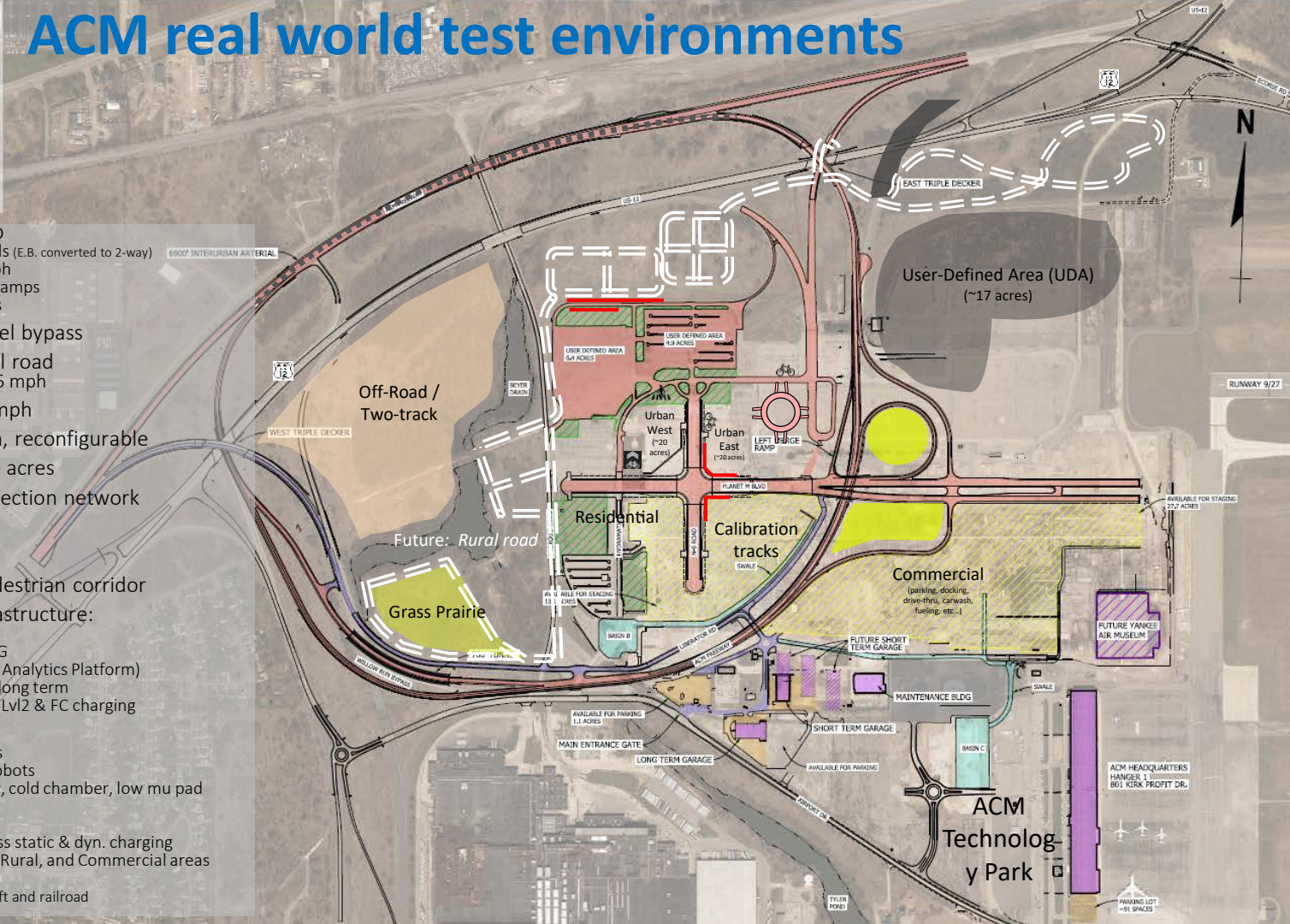
Repurposed

2018

Reopened: December 11, 2017

[2017]

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ACM real world test environments

- 2.5 mile Highway loop
  - Former public roads (E.B. converted to 2-way)
  - 2+ lanes, 50-65 mph
  - Exit and entrance ramps
  - Triple-deck bridges
- 700 foot curved Tunnel bypass
- 1.5 mile urban arterial road
  - 2 lanes, 2-way 55 mph
- 6-lane boulevard 55 mph
- 6 x 6 lane intersection, reconfigurable
- User-defined area, 8+ acres
- Urban canyon / intersection network
- Parking environment
- Roundabout, 2-lane
- 0.5 mile Bicycle & Pedestrian corridor
- Network & other infrastructure:
  - DSRC (15 RSUs)
  - 4G LTE (private), 5G
  - Cloud (Data Mgt & Analytics Platform)
  - Garages – short & long term
  - 90MW substation; Lvl2 & FC charging
- Under development:
  - Guided soft targets
  - Braking/steering robots
  - Weather simulator, cold chamber, low mu pad
  - Signalized corridor
  - Cybersecurity Lab
  - xFC station, wireless static & dyn. charging
  - Residential, 2 mile Rural, and Commercial areas
  - Technology Park
  - Multi-mode: aircraft and railroad

Off-Road / Two-track

User-Defined Area (UDA) (~17 acres)

Urban West (~20 acres)

Urban East (~20 acres)

Residential

Calibration tracks

Future: *Rural road*

Grass Prairie

Commercial (parking, docking, drive-thru, carwash, fueling, etc...)

FUTURE YANKEE AIR MUSEUM

ACM Technology Park

ACM HEADQUARTERS HANGER 1 801 KIRK PROFIT DR.

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PLANET M Website
www.planetm.com