U.S. Department of Transportation
Federal Highway Administration

Turner-Fairbank Highway Research Center

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MAP Creation Tool Progress Update

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Agenda

- Project overview.
- Compiler updates.
- Base map investigation.
- Questions?

Project Overview

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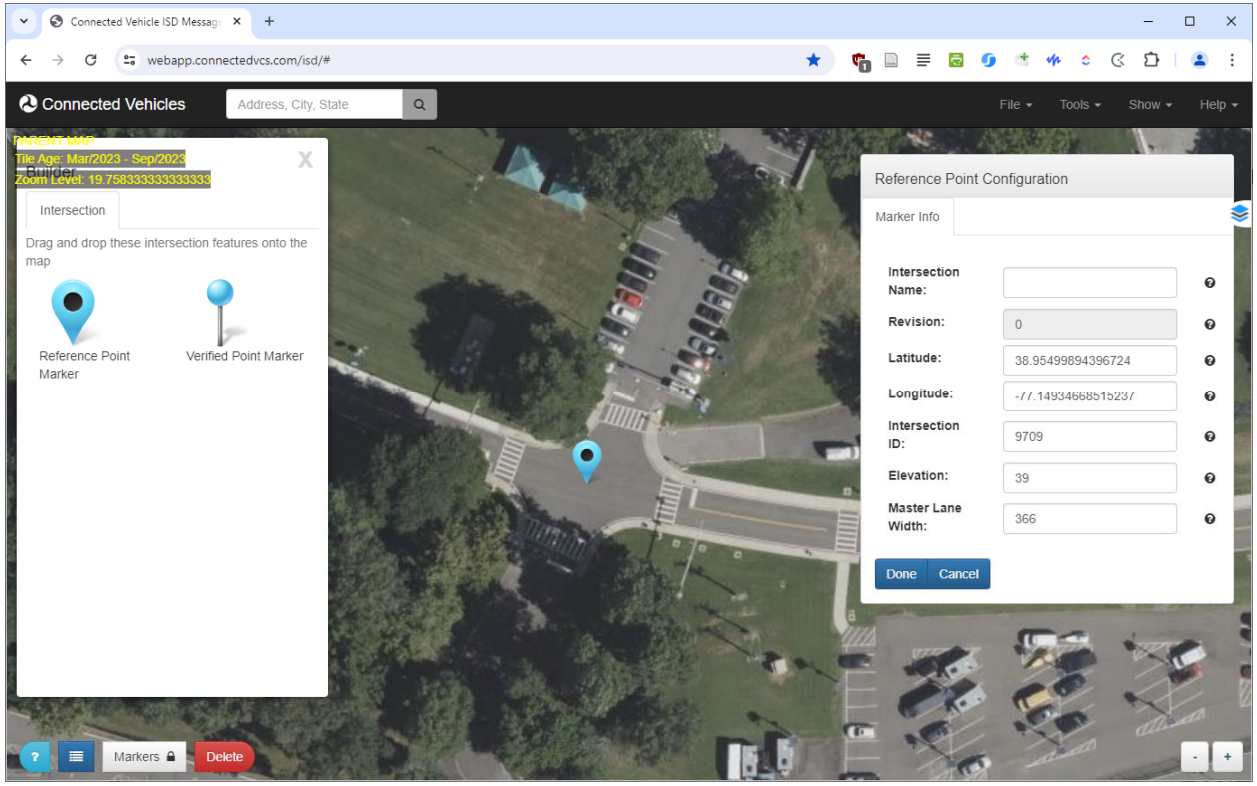
Overview

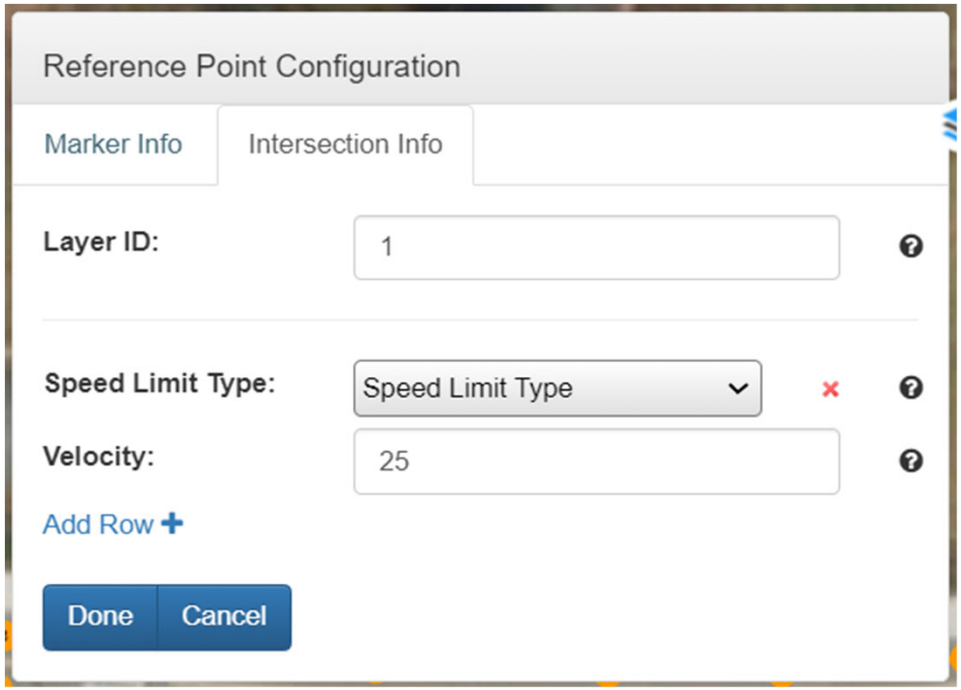
- The current version of the MAP creation tool is widely used and in high demand:[1]
  - Complies with existing SAE International® J2735™ MAP standard.[2]
  - Relies on a proprietary Abstract Syntax Notation One (ASN.1) compiler.[3]
- This project will reassess the existing MAP tool and add capabilities based on input from stakeholders:[1]
  - Eliminate dependence on the proprietary ASN.1 compiler.[3]
  - Include support for the J2945/A message, currently in development.[4]
  - Address stakeholder comments regarding the existing MAP tool.[1]
  - Create a community of practice.

USDOT MAP Tool



Source: FHWA.[1]

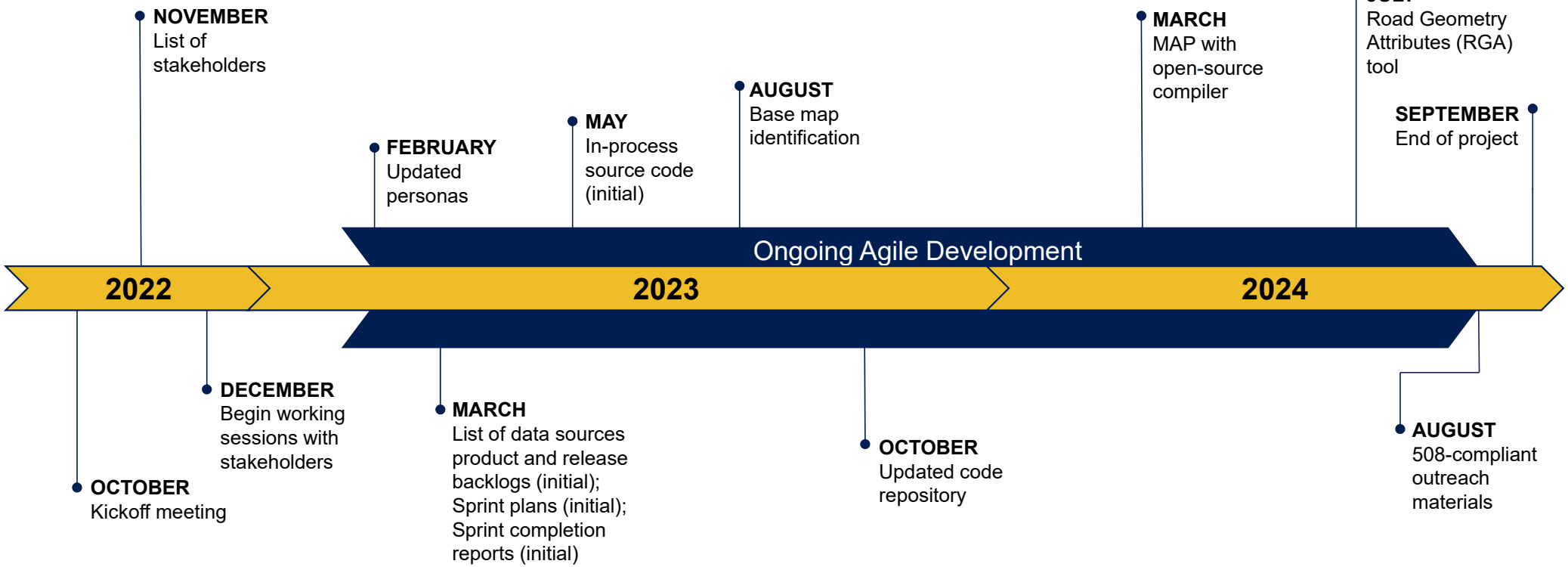
Speed Limits



Can set for an intersection if you make a parent map, then a child map

Source: FHWA.[1]

Timeline



Source: FHWA.

Phases of Work

- Integrate an open-source compiler:
  - Identification of ASN.1c compiler.(3)
  - Integration of ASN.1c compiler into the existing MAP tool.(3,1)
  - Testing of open-source compiler.
- Revisit the base map:
  - Currently supplied by Bing.(5)
  - Four alternatives evaluated.
- Develop support for RGA message: creation of requirements based on the draft standard.(4)

Compiler Updates

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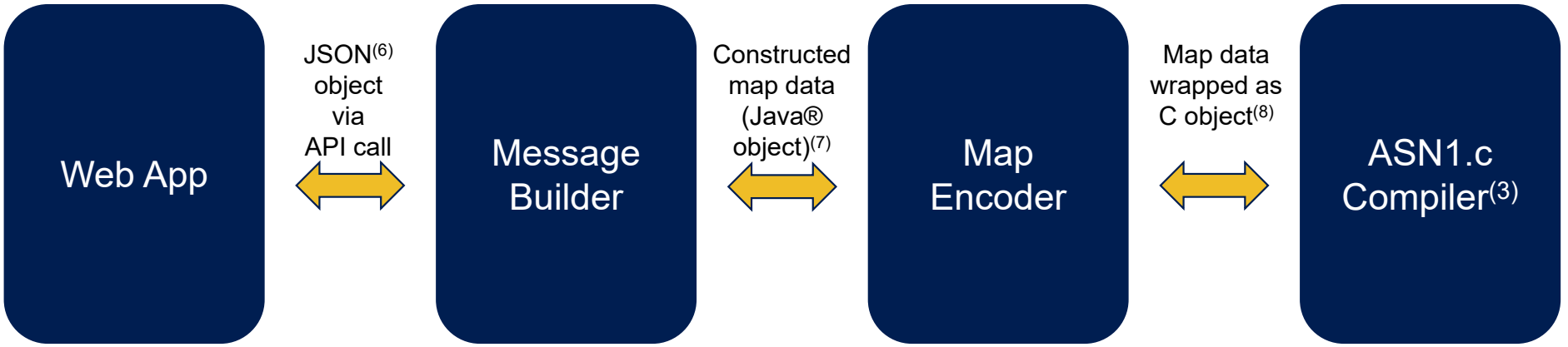
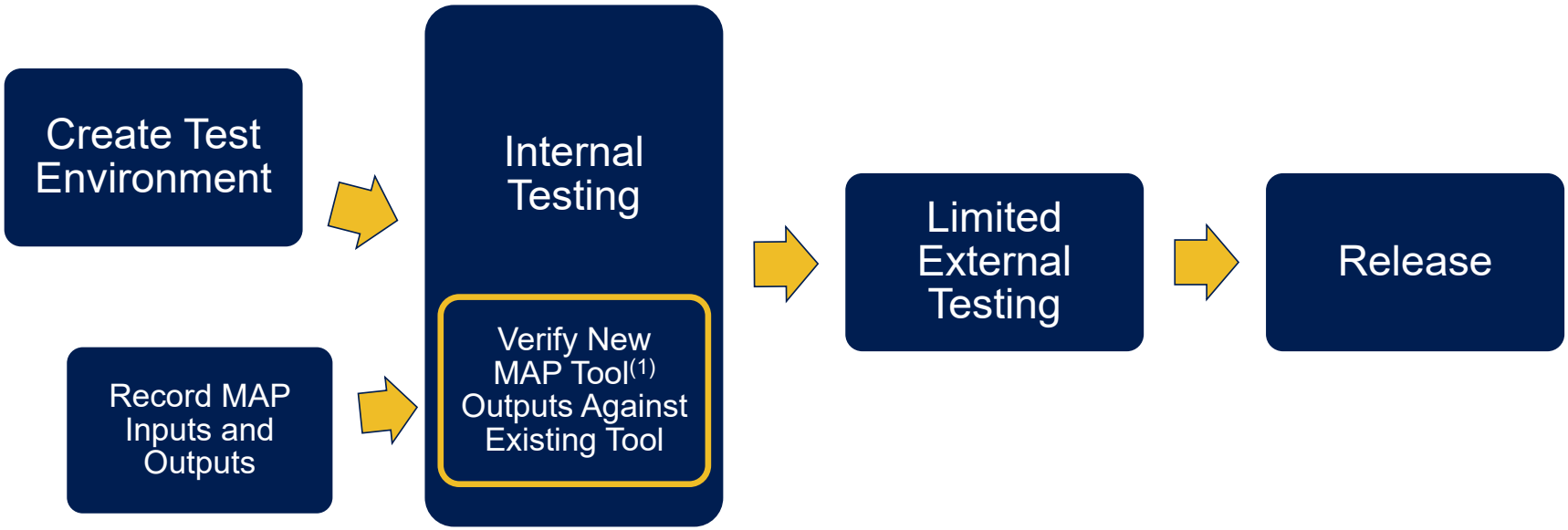
MAP Tool ASN1.c Architecture [1,3]



API = application programming interface.

Source: FHWA.

MAP Tool Open-Source Compiler Testing(1)



Source: FHWA.

Base Map Investigation

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Base Map Investigation Data

Map Source	U.S. Satellite Map Sources	Web Interface/API	Lat/Lon Decimal Places	Altitude Available	Items Used To Compute Precision (m/pixel)			Datum	Projection	Satellite Imagery Year
					Pixels per Tile (N^2) (N)	Max Zoom Level	Max Resolution (m/pixel)			
Google® Earth™[9] and engine (satellite, not 3D imagery)	NASA, USGS, Landsat 8, and many other sources	Web interface	7	Yes	N/A	~23	~0.027	WGS 84[12]	N/A	Accessible, varies by region
		API	7+							
Google Maps® platform[13]	AirBus™, NASA, TerraMetrics™, USGS, Maxar™, and USDA/FPAC/GEO	Web interface	6	Yes	256	21	0.075	WGS 84[12]	Mercator	Accessible, varies by region
		API	7+							
Azure® Maps™[11]	TomTom® and AirBus; unable to identify others	API/SDK only	7+	Yes	256	24	0.009	WGS 84[12]	Mercator	Not accessible
Bing Maps™[5]	TomTom, Vexcel™ Imaging, Earthstar Geographics SIO, and Maxar	Web interface	6	Yes	256	20	0.149	WGS 84[12]	Mercator	Not easily accessible
		API/SDK only	7+							
Mapbox™[10]	NASA MODIS, satellites, Maxar, Nearmap™, and other open and proprietary sources	API/SDK only	7+	Yes	512	22	0.019	WGS 84[12]	Default is Mercator; other options are available	Not accessible

API = application programming interface; FPAC = Farm Production and Conservation; GEO = Group on Earth Observations; Lat = latitude; Lon = longitude; Max = maximum; *N* = number of pixels; N/A = not applicable; NASA = National Aeronautics and Space Administration; N^2 = number of pixels, squared; SDK = software development kit; SIO = Scripps Institution of Oceanography; 3D = three-dimensional; USDA = U.S. Department of Agriculture; USGS = U.S. Geological Survey; WGS = World Geodetic System.

Source: FHWA.

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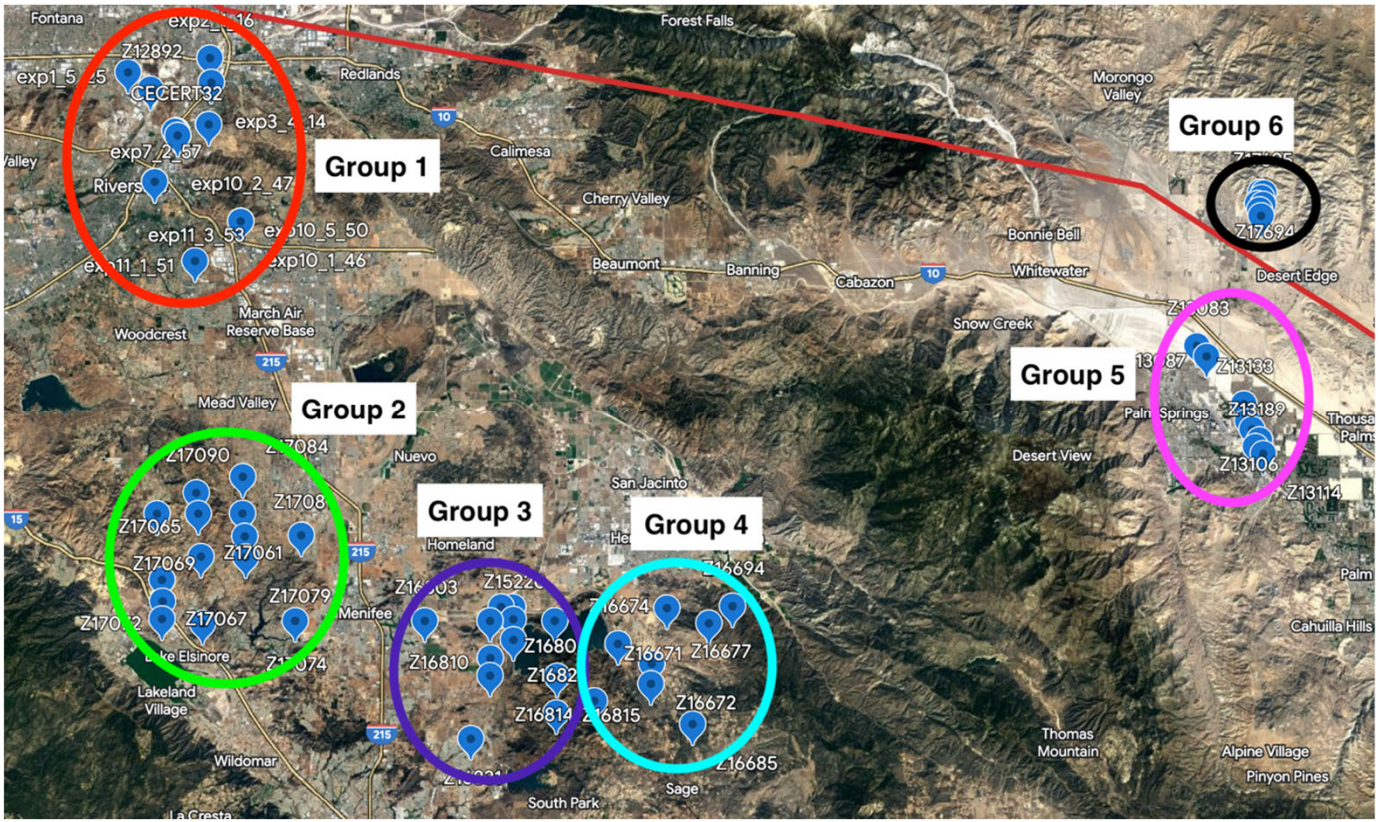
Source: FHWA.

Base Map Evaluation

- Evaluation used points surveyed by the University of California, Riverside, and the Riverside Flood Control District.
- Three researchers independently evaluated each point for each map tile provider.



© 2023 Google Maps®; modified by FHWA.

Results

Map Source	Absolute Error Mean (A/B/C) (m)	Absolute Error Root Mean Squared (A/B/C) (m)	Relative Error Mean (A/B/C) (m)	Relative Error Root Mean Squared (A/B/C) (m)
Google Earth[9]	0.74/0.74/0.74	0.89/0.89/0.89	0.57/0.58/0.56	0.73/0.74/0.71
Mapbox[10]	0.66/0.66/0.65	0.76/0.76/0.75	0.52/0.50/0.51	0.66/0.66/0.65
Microsoft Azure[11]	0.64/0.64/0.64	0.76/0.76/0.76	0.55/0.52/0.54	0.75/0.74/0.76

A = researcher A; B = researcher B; C = researcher C.

Source: FHWA.

Results

Map Source	Absolute Error Mean (A/B/C) (m)	Absolute Error Root Mean Squared (A/B/C) (m)	Relative Error Mean (A/B/C) (m)	Relative Error Root Mean Squared (A/B/C) (m)
Google Earth[9]	0.74/0.74/0.74	0.89/0.89/0.89	0.57/0.58/0.56	0.73/0.74/0.71
Mapbox[10]	0.66/0.66/0.65	0.76/0.76/0.75	0.52/0.50/0.51	0.66/0.66/0.65
Microsoft Azure[11]	0.64/0.64/0.64	0.76/0.76/0.76	0.55/0.52/0.54	0.75/0.74/0.76

A = researcher A; B = researcher B; C = researcher C.

Source: FHWA.

However, only Google Earth displayed all feature points

MAP Versus RGA Message

- MAP is J2735, while RGA is J2945/A.[2,4]
- MAP contains intersection and road geometry data (optional).
- RGA contains road geometry attributes such as base layer, geometry container, movement container, wayuse container, and controlled-intersections container.
- RGA provides additional road information beyond MAP.
- RGA uses a few variables from MAP.

Next Steps

- Make the final release of the MAP tool with the open-source compiler.[1]
- Review existing documentation for J2945/A and guidance from the Connected Vehicle Pooled Fund Study.[4,14]
- Consider and evaluate proposed alternatives for the base map.

Questions?

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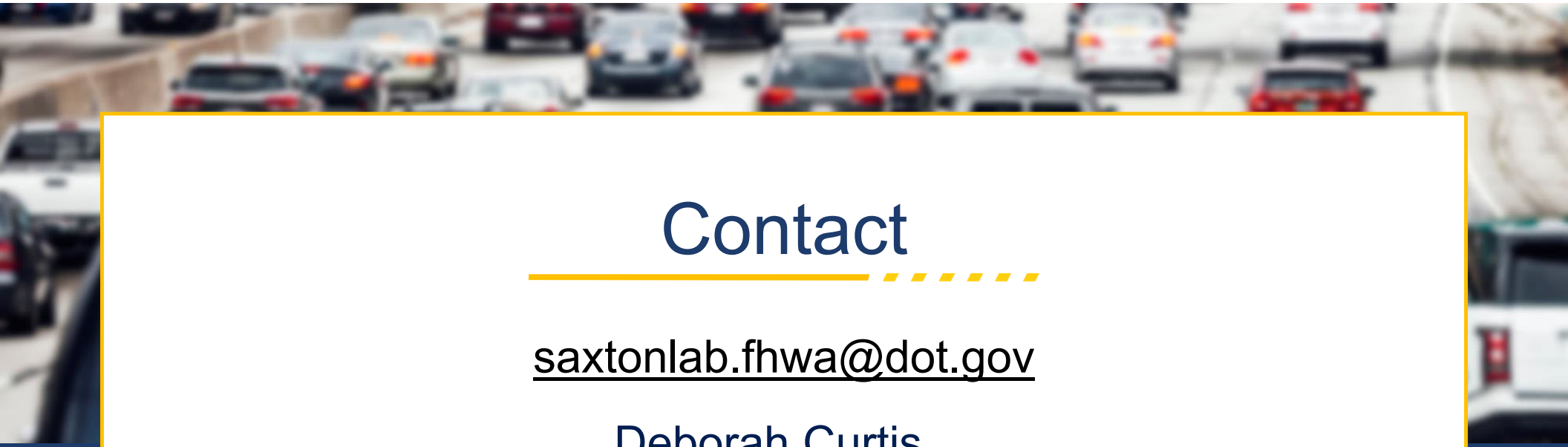

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